

SECTION 31 00 00  
EARTHWORK

**PART 1 - GENERAL**

**1.1 GENERAL PROVISIONS**

- A. The General Documents, as listed in the Table of Contents, and applicable parts of Division 1, GENERAL REQUIREMENTS, shall be included in and made a part of this Section.
- B. Examine all drawings and all other Sections of the Specifications for the requirements therein affecting the work of this trade. Plans, surveys, measurements and dimensions, under which the work is to be performed are believed to be correct to the best of the Owner's knowledge, but the Contractor shall have examined them for himself during the bidding period, as no allowance will be made for any errors or inaccuracies that may be found herein.
- C. Where there is a conflict between drawings, the stricter requirement and the interpretation that most in favor of the owner shall be adopted at no additional cost to the owner.
- D. The Contractor shall become thoroughly familiar with the site, consult records and drawings of adjacent structures and of existing utilities and their connections, and note all conditions which may influence the work of this Section.
- E. By submitting a bid, the Contractor affirms that he has carefully examined the site and all conditions affecting work under this Section. No claim for additional costs will be allowed because of lack of full knowledge of existing conditions.
- F. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure a steady progress of work under this Contract.

**1.2 SCOPE OF WORK**

- A. Work covered by this specification includes the following but is not limited to:
  - 1. Excavation of all types, including but not limited to excavations for footings, slabs, foundations, structures, and utilities, to the lines and grades shown in the Drawings or the limits specified herein, whichever is deeper. Excavation shall include removal and legal offsite disposal of all materials that cannot be reused.
  - 2. Rehandling, hauling and placing of stockpiled materials for use in refilling, filling, backfilling, grading and such other operations. Stockpiling shall include protection to maintain materials in a workable condition.
  - 3. Furnishing, placing, and compacting fill materials.
  - 4. Removing, hauling, stockpiling, rehandling, and placement of materials. Over-excavation to remove unsuitable materials.
  - 5. Proof rolling of exposed subgrade for fill, footings, foundations, slabs, walks, pavements, lawns and grasses, and exterior plants.

6. Backfilling of excavations for foundations, footings, walls, utilities, pavements, sidewalks, and landscaped areas with specified on-site and imported materials.
  7. Off-site disposal of excess or unsuitable materials.
  8. Placement of bedding, sub-base and base course layers.
  9. Stabilization/mitigation of saturated or otherwise disturbed materials.
  10. Final grading.
  11. Fill slopes and site retaining walls.
  12. Excavation support, shoring or bracing as necessary.
  13. Coordination of material testing shall be the responsibility of the Contractor. All imported material tested shall be under ASTM D422 and shall be paid for by the Contractor.
  14. Dust control and cleanup.
  15. Notifying all affected utility companies and Dig Safe before the start of work,
- G. The Work of this Section shall include performance of pre- and post-blasting surveys, preparation of a blast design plan and analysis, and provision of all services in accordance with requirements of 527 CMR 13.00 Explosives and the Contract Documents, for all existing building structures and utilities located within 500 feet of the Limit of Work Line (LOW) as indicated on the Drawings. The Contractor shall coordinate with the Town of Northbridge Fire Department to provide fire watch services before, during, and after all blasting performed under the Contract, in accordance with requirements of 527 CMR 13.00 Explosives and the Contract Documents.

### 1.3 CONTRACT REFERENCE

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections
  1. Section 01 40 00, Quality Control
  2. Section 01 42 00, References
  3. Section 01 50 00, Temporary Facilities

### 1.4 DESCRIPTION

- A. The Contractor shall furnish all labor, material, tools and equipment necessary to excavate materials; segregate, track, handle, sample, analyze, and test excavated materials, backfill, and re-grade as indicated on the Drawings.
- B. The Contractor shall use suitable on-site soils and fill, and soil from off-site sources, as needed. ***Please note that not all on-site materials will be suitable for reuse, nor will all required material gradations be present on the site. Imported materials or blending of onsite materials with blasted rock are anticipated for this project.***

- C. The Contractor shall make excavations in such a manner and to such widths that will provide suitable room for performing the Work and shall furnish and place all sheeting, bracing, and supports, if necessary.
- D. The Contractor shall provide labor and material for all pumping and draining, if necessary; and shall render the bottom of excavation firm and dry and in all respects acceptable. The Contractor shall collect and properly dispose of all discharge water from dewatering systems in accordance with local and State requirements and permits.
- E. The Contractor shall raise the Site to final grades and compact the subgrade and intermediate layers to the required criteria set forth within this Section.
- F. Routine monitoring of in-place excavation support system shall be provided.
- G. Contractor shall protect and moisture condition all on site and imported materials for proper installation, compaction and use. This includes covering, drying, and adding moisture in order to maintain suitable workability of the soil materials.

#### 1.5 INFORMATION

- A. Information on the Drawings, Reference Drawings, and in the Specifications relating to subsurface conditions, natural phenomena, and existing utilities and structures is from the best sources presently available. Such information is furnished only for information and is not guaranteed.
- B. Site Information – Data on indicated subsurface conditions are not intended as representations or warrants of continuity of such conditions between soil borings and test pits. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn there by the Contractor. Data is made available for the convenience of the Contractor. The Owner, Owner and Engineer assume no responsibility for the accuracy of the data other than at the particular locations and at the time the explorations were made.
- C. The Contractor, at his/her own expense, may conduct additional subsurface testing for his/her own information after approval by the Owner.

#### 1.6 SUBSURFACE CONDITIONS AND SPECIAL SITE CONSIDERATIONS

- A. It is the responsibility of the Contractor under this Contract to do the necessary excavation, filling, grading and rough grading to bring the existing grades to subgrade and parallel to finished grades as specified herein and as shown on the Drawings for this Work. The Contractor shall visit the site prior to submitting a bid to become familiar with the extent of the work to be done under this Contract. The Contractor shall be responsible for determining the quantities of earth materials necessary to complete the work under this Section. All earth materials shall be included in the Contractor's base bid.
- B. Any test boring and test pit locations as depicted on the Drawings are located by tape measurements from existing site features and structures and shall only be considered as accurate as the procedure utilized.
- C. No claim for extra cost or extension of time resulting from reliance by the Contractor on information presented herein shall be allowed, except as provided in the Contract Documents.

## 1.7 QUALITY CONTROL

- A. The Owner may retain and pay for the services of an independent testing agency (Soils Representative) to monitor backfill operations, perform laboratory tests on soil samples, and to perform field density tests; and a Geotechnical Engineer to periodically observe the earthwork operations, observe the preparation of the subgrade for footings, slabs, and paved areas, and to review laboratory and field test data. The Owner may from time-to-time request that the contractor excavate test pits ahead of excavation to confirm subsurface conditions. Test pits shall be performed at no additional cost to the Owner.
- B. The Contractor shall make provisions for allowing observations and testing of Contractor's Work by a Geotechnical Engineer and by the independent testing and inspection firm. The presence of the independent testing agency and/or the Geotechnical Engineer does not include supervision or direction of the actual work of the Contractor, his employees or agents. Neither the presence of the independent testing agency and/or the Geotechnical Engineer, nor any observations and testing performed by them, nor failure to give notice of defects shall excuse the Contractor from defects discovered in his work.
- C. Costs related to retesting due to unacceptable quality of work and failures discovered by testing shall be paid for by the Contractor at no additional expense to Owner, and the costs thereof will be deducted by the Owner from the Contract Sum.
- D. The Owner reserves the right to modify the services of the soils representative or Geotechnical engineer.

## 1.8 COORDINATION

- A. Prior to start of earthwork, the Contractor shall arrange an onsite meeting with the Owner, Engineer, the Geotechnical Engineer, and the testing agency for the purpose of establishing the Contractor's schedule of operations, and scheduling observation and testing procedures and requirements.
- B. As construction proceeds, the Contractor shall be responsible for notifying the Geotechnical Engineer at least 2 days and the testing agency at least 24 hours prior to the start of earthwork operations requiring observation and/or testing.
- C. The work of this Section shall be coordinated with that of other trades affecting, or affected by, this work, as necessary to ensure the steady progress of all work of the Contract.

## 1.9 PERMITS, CODES AND SAFETY REQUIREMENTS

- A. This project is subject to the Safety and Health regulations of the U.S. Department of Labor set forth in 29 CFR, Part 1926. Contractors shall be familiar with the requirements of these regulations.
- B. The Contractor is responsible for the adequacy of the excavation support system and shall retain the services of a Professional Engineer registered in Massachusetts to design any required excavation support systems. The Contractor's Professional Engineer shall practice in a discipline applicable to excavation work, shall have experience in the design of excavation support systems and shall design in conformance with OSHA requirements. The Contractor's Professional Engineer shall provide sufficient on-site inspection and supervision to assure that the excavation

support system is installed and functions in accordance with his design. Criteria listed herein defining the responsibilities of the Contractor's Professional Engineer are minimum requirements.

- C. All work shall conform to the Drawings and Specifications and shall comply with applicable codes and regulations.
- D. Comply with the rules, regulations, laws and ordinances of the Town of Northbridge, of the State of Massachusetts, appropriate agencies of the State of Massachusetts and all other authorities having jurisdiction. Coordinate all work done within Town and State rights of way with the appropriate agencies. Provide all required traffic control and safety measures, including uniformed police officers per Town and State requirements. All labor, materials, equipment and services necessary to make the work comply with such requirements shall be provided without additional cost to the Owner.
- E. Comply with the provisions of the Manual of Accident Prevention in Construction of the Associated General Contractors of America, Inc., and the requirements of the Occupational Safety and Health Administration (OSHA), United States Department of Labor whichever is more stringent.
- F. The Contractor shall procure and pay for all permits and licenses required for the complete work specified herein and shown on the Drawings.
- G. The Contractor shall not close or obstruct any street, sidewalk, or passageway unless authorized in writing by the Owner. The Contractor shall so conduct his operations as to interfere as little as possible with the use ordinarily made of roads, driveways, sidewalks or other facilities near enough to the work to be affected hereby. The Contractor shall comply with the time limits established by the terms for trucking onto and off of the site.
- H. Any apparent conflict between the Drawings and Specifications and the applicable codes and regulations shall be referred to the Owner in writing, for resolution before the work is started.
- I. The Contractor shall comply with all excavation, trenching, and related sheeting and bracing requirements of Occupational Safety and Health Administration (OSHA) excavation safety standards, 29 CFR Part 1926.650 through 1926.652.

#### 1.9 LAYOUTS AND GRADES

- A. All line and grade work not presently established at the site shall be laid out by a survey team under the supervision of a Land Surveyor or Professional Engineer registered in the Commonwealth of Massachusetts and employed by the Contractor in accordance with Drawings and Specifications. Basic layout for the project is shown on the drawings. The Contractor shall supply all additional layout and grade control as necessary to properly implement and construct the work. The Contractor shall establish permanent bench marks and replace as directed any which are destroyed or disturbed.
- B. The words "finished grades" as used herein shall mean final grade elevations indicated on the Drawings. Spot elevations shall govern over proposed contours. Where not otherwise indicated, project site areas outside of the building shall be given uniform slopes between points for which finished grades are indicated or between such points and existing established grades.

- C. The word “subgrade” as used herein, means the surface or elevation remaining after completing excavation or top surface of a fill or backfill required surface of borrow fill or compacted fill. This surface is immediately beneath the site improvements, fill materials as dimensioned on the Drawings, or other proposed surface material.
- D. All layouts and grades shall be in accordance with Section 01 36 00 FIELD ENGINEERING.

#### 1.10 DISPOSITION OF EXISTING UTILITIES

- A. All work shall be executed in such a manner as to prevent any damage to existing buildings, streets, curbs, paving, service utility lines, structures and adjoining property. Existing streets, sidewalks and curbs damaged during the project work shall be repaired or replaced to their condition prior to commencement of Earth Moving operations.
- B. Locate and mark underground utilities to remain in service before beginning the work. Active utilities existing on the site and work areas shall be carefully protected from damage and relocated or removed as necessitated by the work. When an active utility line is exposed during construction, its location and elevation shall be plotted on the record drawings as described in this Section and both Owner and Utility Owner notified in writing.
- C. Inactive or abandoned utilities encountered during construction operations shall be removed and suitably backfilled if within the building area. Abandoned utilities outside the building area shall be removed, grouted, plugged or capped. The location of such utilities shall be noted on the record drawings and reported in writing to the Owner.
- D. The Contractor shall notify “Dig Safe” and local utility companies prior to the start of construction. The “Dig Safe” number shall be submitted by the Contractor in writing to the Owner prior to construction.
- E. Acceptance of any of the Contractor’s plans, design calculations and methods of construction by the Designer shall not relieve the Contractor of the responsibility for the adequacy of the excavation lateral support system; preventing damage to existing or new structures, utilities and streets adjacent to excavations; the safety of persons working within excavated areas and the public at large; and excavation dewatering.

#### 1.11 SUPPORT OF EXCAVATION

- A. Provide support of excavation (SOE) system, in order to meet the requirements of OSHA and to assure complete safety against collapse of earth at sides of excavations. The contractor shall design and submit for review and upon approval install a temporary support of excavation (SOE) to protect the existing foundations during construction.
- B. In selecting the type of SOE system, the Contractor shall take into consideration the possible presence of rock and the presence of boulders in the existing fill and in the natural soil.
- C. If, at any place, sufficient or proper supports have not been provided, additional supports shall be placed at the expense of the Contractor. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and rammed.

- D. All components of SOE system not ordered left in place shall be carefully removed in such a manner as not to endanger the construction of other structures, utilities or property whether public or private. All voids left after withdrawal of sheeting shall be immediately refilled with sand and rammed with tools especially adapted to that purpose or otherwise compacted as directed to achieve the required density.
- E. The design and installation of SOE systems shall not constitute a condition for which an increase may be made in the contract price with the exception that if the Owner directs with writing that certain shoring or sheeting shall be left in place, the contract price will be adjusted in accordance with General Conditions.
- F. SOE systems shall be designed to support the earth pressures, surcharge loads from stored material and construction equipment.
- G. Shoring and bracing of trenches and other excavations shall, at a minimum, be in accordance with the latest requirements of the Department of Labor and Industries Bulletin No. 12, Section 10, and all subsequent amendments, and OSHA excavation safety standards.
- H. SOE systems shall be designed by a Professional Engineer registered in the Commonwealth of Massachusetts and hired by and paid for by the Contractor.

#### 1.12 DRAINAGE AND GROUNDWATER CONTROL

- A. The Contractor shall control the grading in areas under construction on the site so that the surface of the ground will properly slope to prevent accumulation of groundwater and surface water in excavated areas and adjacent properties.
- B. The Contractor shall provide, at his own expense, adequate pumping and drainage facilities to maintain the excavated area sufficiently dry from groundwater and/or surface runoff so as not to adversely affect construction procedures nor cause excessive disturbance of underlying natural ground. The flows of all water resulting from pumping shall be managed so as not to cause erosion, siltation of drainage systems, or damage to adjacent property.
- C. Damage resulting from the failure of the dewatering operations of the Contractor, and damage resulting from the failure of the Contractor to maintain all the areas of work in a suitable dry condition, shall be repaired by the Contractor, as directed by the Engineer, at no additional expense to the Owner. The Contractor's pumping and dewatering operations shall be carried out in such a manner as to prevent damage to the Contract work and so that no loss of ground will result from these operations. Precautions shall be taken to protect new work from flooding during storms or from other causes. Pumping shall be continuous to protect the work and/or to maintain satisfactory progress.
- D. All pipelines or structures not stable against uplift during construction or prior to completion shall be thoroughly braced or otherwise protected. Water from the trenches, excavations, and stormwater management operations shall be disposed of in such a manner as to avoid public nuisance, injury to public health or the environment, damage to public or private property, or damage to the work completed or in progress.
- E. The Contractor shall excavate interceptor swales and ditches, as necessary, prior to the start of major earthmoving operations to insure minimal erosion and to keep areas as free from surface and ponded water as possible.

- F. All piping exposed above ground surface for this use, shall be properly covered to allow foot traffic and vehicles to pass without obstruction.
- G. Presence of groundwater or stormwater in soil will not constitute a condition for which an increase in the contract price may be made. Under no circumstances place concrete fill, lay piping or install appurtenances in excavation containing free water. Keep utility trenches free of water until pipe joint material has hardened and backfilled to prevent flotation.
- H. For further information refer to paragraphs on SPECIAL REQUIREMENTS FOR SEQUENCE OF CONSTRUCTION OPERATIONS AND DRAINAGE AND EROSION CONTROL as specified herein.

#### 1.13 FROST PROTECTION/WORK IN FREEZING WEATHER

- A. Protect excavation bottoms and sides against freezing.
- B. A layer of fill shall not be left in an uncompacted state at the close of a day's operation when there is the potential for that layer to freeze.
- C. The Contractor shall not place any material on snow, ice, frozen soil, or soil that was permitted to freeze prior to compaction. Removal of these unsatisfactory materials will be at the Contractor's expense.
- D. Do not excavate to full indicated depth when freezing temperatures may be expected, unless work can be completed to subgrade, the materials installed, and the excavation backfilled the same day. Protect the excavation from frost if placing of materials or backfilling is delayed.
- E. The Contractor shall keep the operations under this Contract clear and free of accumulation of snow within the limits of Contract Lines as necessary to carry out the work.
- F. No materials shall be installed on frozen ground. Fill materials shall be free of frost.
- G. The subgrade of footings and slabs shall be protected from frost before placing concrete. The subgrade on the sides of the footings shall be protected from frost after the footings are constructed until sufficient fill is placed to protect the bottom of footings from frost induced heave.

#### 1.14 DISTURBANCE OF EXCAVATED AND FILLED AREAS DURING CONSTRUCTION

- A. The Contractor shall take the necessary steps to avoid disturbance of subgrade and underlying natural soils/compacted fill during excavation and filling operations. Methods of excavation and filling operations shall be revised as necessary to avoid disturbance of the subgrade and underlying natural soils/compacted fill, including restricting the use of certain types of construction equipment and their movement over sensitive or unstable materials. The Contractor shall coordinate with the Owner or Soils Representative to modify his operations as necessary to minimize disturbance and protect bearing soils, based on the Owner's or Soils Representative's observations.
- C. All excavated or filled areas disturbed during construction, all loose or saturated soil, and other areas that will not meet compaction requirements as specified herein shall



be removed and replaced with compacted Sand Gravel Fill or Crushed Stone. Fill that cannot be compacted within 48 hours because of its saturated condition shall be removed and replaced with compacted Sand Gravel Fill or Crushed Stone. Costs of removal of disturbed material and replacement with Sand Gravel Fill or Crushed Stone shall be borne by the Contractor.

- C. If requested by the Owner, the Contractor shall place a six inch layer of Crushed Stone or 12 inch layer of Granular Fill over natural underlying soil to stabilize areas disturbed during construction.
  - 1. The placement of the Crushed Stone layer or Granular Fill as well as material costs shall be borne by the Contractor.
- D. Material that is above or below optimum moisture for compaction of the particular material in place as determined by the Owner or the Soils Representative and is disturbed by the Contractor during construction operations so that proper compaction cannot be reached shall be construed as unsuitable bearing materials. This material shall be removed and replaced with lean concrete, Sand Gravel Fill, or Crushed Stone as directed by the Owner or Soils Representative at no additional cost to the Owner.

1.15 SPECIAL REQUIREMENTS FOR SEQUENCE OF CONSTRUCTION OPERATIONS AND DRAINAGE AND EROSION CONTROL

- A. An initial procedure for sequencing of construction operations is specified under Section 31 25 00, EROSION CONTROL. This procedure shall be extended through earthwork operations as follows:
  - 1. Perform initial procedures as specified under Section 31 25 00, EROSION CONTROL – Initial Sequence of Construction Activities and Preliminary Drainage Control.
  - 2. Repair any broken or damaged Sections of the haybales or siltation fencing installed during site preparation and install any additional Sections necessary for proper erosion control.
  - 3. Throughout earthwork operations, in addition to drainage swales, check dams, siltation sumps, and other items shown on the Drawings, the Contractor shall take other necessary precautions, including installation of temporary drainage swales, siltation sumps, check dams, haybales, silt fencing and temporary pipe to direct and control drainage from disturbed areas on the site so that erosion and siltation is minimal. In addition, no erosion or discharge of silt or larger particles shall occur in water bodies or wetland areas to remain undisturbed or onto adjacent properties.
  - 4. Damaged or loose haybales and siltation fence shall be replaced as necessary to maintain their function of controlled erosion and siltation. Damaged or broken down check dams and filtration dams shall be replaced immediately.
  - 5. Throughout construction, remove any accumulation of silt or soil build-up behind haybales, silt fences, check dams and filtration dams as it occurs. Remove accumulations of silt and build-up from the siltation pumps and silt traps when it is approximately 18 inches deep, or when it adversely affects the performance of the system. Remove silt sacks in catch basins when they have become clogged and replace to maintain their function.
  - 6. Replace the crushed stone on the inside of all siltation sumps as necessary to permit adequate flow through the media and to maintain their function as a filter of silt and larger particles. Excavate silt and other material from the basins of all siltation sumps as it accumulates.

7. Remove temporary drainage swales, check dams, siltation sumps, haybales and other temporary drainage, erosion and siltation control measures when permanent drainage control measures have been installed, and grass is established in drainage areas and lawn areas. Do not remove the above items without approval of the Owner. If, in the Owner's opinion, these measures are still necessary, they shall stay in place.

#### 1.16 DEFINITIONS

- A. Backfill: Soil material used to fill an excavation.
  1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
  2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Course placed between the grade and hot-mix asphalt paving.
- C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Building Area: the area defined by the projection of a line from two foot outside of the edge of the footing extending upward and outward at a slope of 1H:1V or 5 feet beyond the limits of the building, whichever is greater,
- F. Compaction: The tamping and rolling of all backfill placed in uniform horizontal layers not exceeding a defined uncompacted lift thickness.
- G. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- H. Deleterious Material: Trash, debris, clay, topsoil, roots, organic material friable, glass, or otherwise degradable materials that compromise the strength and properties of soils.
- I. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated. Excavation is unclassified.
  1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Owner. Authorized additional excavation and replacement material will be paid for according to Contract provisions.
  2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Owner. Unauthorized excavation, as well as remedial work directed by Owner, shall be without additional compensation.
- J. Fill: Soil materials used to raise existing grades or meet proposed grades.
- K. Frost Zone: The area within 4 feet of finished grade.
- L. Influence Area: The area below a footing defined by the projection of a line from two foot outside of either edge of the footing extending downward and outward at a slope of 1V:1H.

- M. "In-the-dry": In-situ soil moisture content of no more than two percentage points above the optimum moisture content for that soil.
- N. Optimum Moisture Content: Determined by the ASTM standard specified to determine the maximum dry density for relative compaction.
- O. Prepared Ground Surface: The ground surface after clearing, grubbing, stripping, excavation, and scarification and/or compaction.
- P. Proof-rolling: The tamping and rolling of all subgrades including running a loaded rubber tire truck over the subgrade when requested by the Geotechnical Engineer.
- Q. Relative Density: As defined by ASTM D4253 or D4254.
- R. Relative Compaction: The ratio, in percent, of the as-compacted field dry density to the laboratory maximum dry density as determined by ASTM D1557. Corrections for oversized material may be applied to either the as-compacted field dry density or the maximum dry density, as determined by the Owner.
- S. State Standards: Massachusetts Highway Department Standard Specifications for Highways and Bridges.
- T. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- U. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- V. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- W. Unclassified Excavation: The nature of materials to be encountered has not been identified or described herein.
- X. Unsuitable material shall be material having at least one of the following properties:
  - 1. Material with a maximum unit dry weight per cubic foot less than 110 lbs., as determined by ASTM D1557.
  - 2. Material containing greater than 3% organic matter by weight, topsoil, organic silt, peat, construction debris, roots and stumps.
  - 3. Material which has a Liquid Limit greater than 55 when tested in accordance with ASTM D 4318.
  - 4. Materials that do not meet one of the gradation specifications in this section.
  - 5. Material classified as unsuitable by the Geotechnical Engineer.
  - 6. Unsuitable material shall be disposed of off-site as directed by the Owner.
  - 7. Material processed onsite that is not well graded or contains excess stones and exhibits honeycombing when placed in lifts.
  - 8. Materials that are unstable as a result of inadequate construction dewatering, excessive subgrade disturbance, or other means and methods used by the Contractor are not considered unsuitable materials. This includes materials that were stable and that have become unstable.
- Y. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.17 REFERENCES

- A. American Society of Testing and Materials Publications
- B. Massachusetts Highway Department Standard Specifications for Highways and Bridges.

1.18 SUBMITTALS

- A. Product Data: For the following:
  - 1. Each type of plastic warning tape.
  - 2. Geotextile.
  - 3. Controlled low-strength material, including design mixture.
- B. Submit a detailed construction sequence plan for project excavation indicating temporary stockpile areas, side slopes of excavations, limits of required temporary excavation support and sequence and procedures for subgrade protection, excavation, concrete placement, moisture conditioning of on-site excavated soils used as fill, filling, backfill, and compaction.
- C. The Contractor shall submit under provisions of Section 01 33 00, the name of imported material suppliers. Change of source suppliers shall require approval from the Owner.
- D. Grain-size distribution analysis test data shall be delivered with the samples. The analysis shall be performed in accordance with ASTM D 422. The data shall include a plot of the gradation and the envelope of the specified material. A material shall be considered meeting the specifications when its gradation curve fits entirely within the specified envelope.
- E. The Contractor shall submit to the Owner, under provisions of Section 01 33 00, manufacturer's literature and data on proposed compaction equipment.
- F. The Contractor shall provide to the Owner, on a daily basis, copies of field records documenting the location of stockpiled material, and stockpile identification data.
- G. The Contractor shall submit a scale plan daily that defines the location, limits, and depths of the area excavated.
- H. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
  - 1. Classification according to ASTM D 2487 of each onsite and borrow soil material proposed for fill and backfill.
  - 2. Laboratory compaction curve according to ASTM D 1557 for each on-site and borrow soil material proposed for fill and backfill.
- I. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earthwork operations. Submit before earthwork begins.
- J. Excavation and Excavation Support Plan: Submit at least 10 calendar days prior to the start of the work a detailed plan for the sequence of excavation, and methods to be used for excavation support and dewatering of excavations. Submit engineering calculation stamped by a Massachusetts Registered Professional Engineer and shop drawings for earth support systems to be used. Dewatering and groundwater control

systems shall be designed to keep excavations free of water and to avoid disturbance of the subgrade.

- K. The contractor shall submit a blasting plan, including blasting sequence, blasting methods, method of measuring blasted quantities, limits of pre-blast survey, and measures to limit vibrations below the limits in these specifications.

#### 1.19 SAMPLING AND TESTING

- A. A 50-lb. Sample of each off-site material proposed for use, and of any on-site material when so requested by the Owner, Soils Representative, or the geotechnical engineer shall be submitted for testing by the testing agency.
  - 1. Samples shall be delivered to the office of the Owner or as directed.
  - 2. Samples required in connection with compaction tests will be taken and transported by the Soils Representative.
  - 3. If approval is based on the test results from a sample of material to be imported, additional tests, including grain-size analyses and laboratory compaction tests shall be performed on the material after it is delivered to the site.
- B. Product Data: Submit location of pits for borrow material.
- C. Samples shall be representative of the source pit. If materials are found to vary once construction begins, the Contractor will be required to submit additional representative samples at his own cost.
- D. Materials imported to the site by the Contractor for on-site use shall not contain oil, hazardous waste, or deleterious materials.
  - 1. The Contractor shall be responsible for all costs incurred by the Owner as a result of the Contractor's action to import materials containing concentrations of oil and/or hazardous materials to the site.
  - 2. In the event that site characterization of off-site borrow sources indicates that soils are acceptable to the Owner or Engineer for use, then chemical testing will not be required. It is anticipated that chemical testing would not normally be required for material from customarily utilized commercial borrow sources.

No fill material from "urban areas" will be accepted for fill at the site, even if chemical testing indicates no exceedances of "Reportable Concentrations".

If requested by the Owner or Engineer, based on review of the borrow site characterization, the Contractor shall conduct testing on proposed fill material and submit results prior to delivery to the site, at no additional cost to the Owner. Testing shall be conducted by a DEP-certified testing laboratory and shall include, at a minimum, the following analytical test data.

    - a. Total Petroleum Hydrocarbons (EPA Method 418.1) every 100 yards
    - b. Volatile Organic Compounds (EPA Method 8420) every 500 yards
    - c. PCB and Pesticides (EPA Method 8080) every 500 yards
    - d. Total RCRA Metals (EPA Method 6000-7000 series) every 500 yards
    - e. Polynuclear Aromatic Hydrocarbons (EPA Method 8270) every 500 yards
    - f. TCLP for those total parameters which exceed twenty times the TCP criteria every 500 yards
    - g. Total cyanide (EPA 9020)

3. All off-site material submitted for use on the project site shall conform to the S-1 Soils Standards contained in the Massachusetts Contingency Plan, dated October 1, 1993, Section 310 CMR 40.0975 or site soil background levels, whichever is lower. Samples will be chemically tested to determine their conformance with the S-1 Soils Standards and site soil background levels.
4. Testing parameters and testing frequencies may be reduced, as directed by the Soils Representative.
5. All sieve analyses for conformance of on-site and off-site fill materials to be used in the work shall be done by means of a mechanical wet sieve analysis and in accordance with ASTM D 422 with a sieve stack containing at a minimum the sieve sizes contained in the Structural Fill table.

#### 1.20 QUALITY ASSURANCE

- A. Subgrades shall be approved for compactness and material composition by the Owner prior to placing subsequent lifts. If inspections indicate Work does not meet specified requirements, the Work shall be removed, replaced and compacted at no additional cost to the owner or Owner.
- B. Pre-excavation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
  1. Before commencing earthwork, meet with representatives of the governing authorities, Owner, Owner, Engineer, consultants, independent testing agency, and other concerned entities. Review earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least 3 working days prior to convening conference. Record discussions and agreements and furnish a copy to each participant.
- C. Testing: Compaction tests will be required by the Owner and will be paid for by the owner. No specific testing schedule has been established at this time. If tests indicate that density requirement have not been achieved, the contractor continue compacting the tested material. All retesting in these areas shall be paid for by the contractor.
- D. The Owner's Testing Agency will perform water content, gradation tests on onsite and processed materials, and compaction tests at a frequency and at locations as required. The results of these tests will be submitted to the Owner, and a copy submitted to the Contractor, on a timely basis so that the Contractor can take such action as is required to remedy the indicated deficiencies.
- E. Contractor shall notify Owner when excavations have reached required subgrade and provide a minimum notice of 48 hours prior to placement of backfill on exposed subgrade. Density and Compaction Testing: The contractor is responsible to schedule compaction tests and allow adequate time for the proper execution of said tests.

#### 1.21 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by the owner or others unless permitted in writing by Owner and then only after arranging to provide temporary utility services according to requirements indicated.
  1. Notify Owner not less than two days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without Owner's written permission.
  3. Contact a utility-locator service for the area where Project is located before excavating.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies and Town of Northbridge to shut off services if lines are active.
  - C. Subsurface investigations indicated the presence of fill material which contains organic matter. This material has limited reuse applications at the site.
  - D. All fill to be removed from the Building Area and Influence Zone as presented on the plans and described herein.
  - E. Subsurface investigations indicated the presence of sandy materials which will likely be easily disturbed due to construction activities. This material is also likely to require regular moisture conditioning to obtain required compaction requirements.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Segregate excavated material based upon material type to enable reuse in appropriate locations based upon material type.
- B. Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

### **2.2 SOIL MATERIALS**

- A. Use of materials shall be as described below and as shown in the Drawings.
- B. Fill material will not be accepted from off-site borrow sources that are Massachusetts DEP MCP disposal sites. Common borrow material obtained from off-site borrow sources that have no known releases or disposal of oil and/or hazardous material shall be acceptable for use only when accompanied by documentation stating there has been no known releases or disposal of oil and/or hazardous materials at the off-site borrow site.
- C. Fill material shall be free from frost/ice and snow, rocks with a diameter greater than 2/3 of the loose lift thickness as specified herein, and foreign matter, such as construction debris, asphalt, trash, wood, roots, leaves, sod, and organic matter. All fill material shall be maintained by the contractor at suitable moisture contents for proper placement and compaction as specified herein.
- D. Offsite pulverized pavement and crushed concrete are not acceptable for fill material. Onsite concrete that is crushed to meet one of the gradation requirements specified herein can be used as backfill.

### **2.3 STRUCTURAL FILL**

- A. Structural fill shall have a plasticity index of less than 6, and shall meet the gradation requirements shown below. Structural Fill shall be compacted in maximum 9-inch loose lifts to at least 95 percent of the Modified Proctor maximum dry density (ASTM D1557), with moisture contents within  $\pm 2$  percentage points of optimum moisture content.

Sieve Size	Percent Passing by Weight
3 inches	100
1 ½ inch	70 – 100
½ inch	45 – 100
No. 4	30 – 85
No. 20	15 – 60
No. 60	5 – 35
No. 200*	0 - 10

\*0 – 5 Under sidewalks and unheated slabs, exterior pads and stairs

- B. Use structural fill within building areas beneath floor slabs, foundations, and in other soil-bearing situations. Use Structural Fill with less than 5 percent fines in top 12 inches under exterior slabs-on-grade including under sidewalks

## 2.4 ORDINARY FILL

- A. Ordinary Fill shall have a plasticity index of less than 6, and shall meet the gradation requirements shown below. Ordinary Fill shall be compacted in maximum 9-inch loose lifts to at least 95 percent of the Modified Proctor maximum dry density (ASTM D1557), with moisture content s within  $\pm 2$  percentage points of optimum moisture content.

Sieve Size	Percent Passing by Weight
6 inches	100
1 inch	50 – 100
No. 4	20 - 100
No. 20	10 - 70
No. 60	5 – 45
No. 200	0 - 20

- B. Use Ordinary Fill for general grading; as backfill for embankments, behind the free draining backfill behind retaining walls, landscape areas; and beneath the subbase layer in paved areas outside the building footprint.

## 2.5 COMMON BORROW

- A. Common Borrow material shall be soil containing no stone larger than 8 inches and shall be substantially free of organic loam, wood, trash, or other objectionable materials which may be decomposable, compressible or which cannot be properly compacted. Common Borrow materials shall not contain more than 30 percent by weight of silt and clay.
1. No Common Borrow shall be imported until available onsite Ordinary Fill has been utilized or with prior written approval from the Owner.
  2. Common Borrow material from off-site borrow sources shall contain no detectable concentrations of asbestos.



## 2.6 GRAVEL BORROW

- A. Granular Fill shall be onsite or imported material conforming to Item M1.03.0 type a or b of the State Standards.
- B. Sand Gravel Fill shall be onsite or imported material conforming to Item M1.03.0 type b of the State Standards.
- C. Processed Gravel shall be onsite or imported material conforming to Item M1.03.1 of the State Standards.
- D. Gravel Borrow materials are not anticipated to be present onsite.

## 2.7 BEDDING MATERIAL

- A. Gravel Borrow Bedding Material shall be imported material conforming to Item M1.03.0 type c of the State Standards.
- B. Crushed Stone Bedding Material shall be imported material conforming to Item M2.01.3 of the State Standards.
- C. Coarse Sand Bedding Material shall be imported material conforming to Item M1.04.0 type A of the State Standards.
- D. Dense Grade Crushed Stone shall be imported material conforming to Item M2.01.7 of the State Standards.

## 2.8 CRUSHED STONE

- A. Crushed Stone shall be impacted durable material with maximum of 1 ½ " or 2" as specified in the Drawings. Stone used for drainage components shall be double washed. For all other applications fines shall be <1% unless otherwise noted. Crushed stone shall meet the following gradation:

Size (inches)	Percent Finer
1 ½" – 2"	100%
1 ¼"	85% - 100%
¾"	10% - 40%
½"	0% - 8%
#200	< 1%

- B. ¾" Crushed Stone shall comply with State Standards M2.01.4.
- C. ¼" to 3/8" Crushed Stone shall comply with State Standards M2.01.6.

## 2.9 PEA GRAVEL

- A. Clean naturally rounded aggregate with particle sizes no larger than ¾ of an inch with no more than 5% passing the #8 sieve. The dry density shall be a minimum of 95 pounds per cubic foot.

## 2.10 GEOTEXTILE FABRIC

- A. Geotextile No. 1: Geotextile Fabric for erosion control/slope protection shall conform to Item M9.50.0 type IV of the State Standards. Geotextile No. 1 is a nonwoven geotextile composed of polypropylene fibers, which are formed into a stable network such that

fibers retain their relative position. The product is inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids.

<b>Mechanical Properties</b>	<b>Test Method</b>	<b>Unit</b>	<b>Minimum Average Roll Value</b>
Grab Tensile Strength	ASTM D 4632-91	lbs	120
Grab Tensile Elongation	ASTM D 4632-91	%	50
Trapezoid Tear Strength	ASTM D 4533-91	lbs	50
Mullen Burst Strength	ASTM D 3786-87	psi	225
Puncture Strength	ASTM D 4833-00	lbs	65
Apparent Opening Size (AOS)	ASTM D 4751-99A	U.S. Sieve	70
Permittivity	ASTM D 4491-99A	sec <sup>-1</sup>	1.8
Permeability	ASTM D 4491-99A	sec	0.21
Flow Rate	ASTM D 4491-99A	gal/min/ft	135
UV Resistance (at 500 hours)	ASTM D 4355-02	% strength retained	70

<b>Physical Properties</b>	<b>Test Method</b>	<b>Unit</b>	<b>Typical Value</b>
Weight	ASTM D 5261-92	oz/yd	4.8
Thickness	ASTM D 5199-01	mils	55
Roll Dimensions (width x length)	--	ft	12.5 x 360 / 15 x 360
Roll Area	--	yd	500 / 600
Estimated Roll Weight	--	lb	164 / 197

- B. Geotextile No. 2: Geotextile No. 2 is a nonwoven geotextile composed of polypropylene fibers, which are formed into a stable network such that fibers retain their relative position. The product is inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids.

<b>Mechanical Properties</b>	<b>Test Method</b>	<b>Unit</b>	<b>Minimum Average Roll Value</b>
Grab Tensile Strength	ASTM D 4632	lbs	160

Grab Tensile Elongation	ASTM D 4632	%	50
Trapezoid Tear Strength	ASTM D 4533	lbs	60
Mullen Burst Strength	ASTM D 3786	psi	305
Puncture Strength	ASTM D 4833	lbs	95
Apparent Opening Size (AOS)	ASTM D 4751	U.S. Sieve	70
Permittivity	ASTM D 4491	sec <sup>-1</sup>	1.4
Permeability	ASTM D 4491	sec	0.22
Flow Rate	ASTM D 4491	gal/min/ft	110
UV Resistance (at 500 hours)	ASTM D 4355	% strength retained	70

Physical Properties	Test Method	Unit	Typical Value
Weight	ASTM D 5261	oz/yd	6.4
Thickness	ASTM D 5199	mils	75
Roll Dimensions (width x length)	--	ft	15 x 300
Roll Area	--	yd	500
Estimated Roll Weight	--	lb	217

- C. Geotextile No. 3: Geotextile for the installation of underground tank
  - 1. Woven geotextile fabric with a minimum grab tensile strength of 120 lbs/inch and a maximum apparent opening size of #50 US sieve (0.300 mm)
- D. A geotextile fabric shall not be used between crushed stone and soil fill material at the base of retaining walls. Where separation between crushed stone and soil fill material is required, the crushed stone shall be choked by means of a soil filter.

## 2.11 OTHER SOIL MATERIAL

- A. Drainage Aggregate: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.
- B. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch (25-mm) sieve and 0 to 5 percent passing a No. 4 (4.75-mm) sieve.

- C. Fine Aggregate: ASTM C 33; fine aggregate, natural, or manufactured sand.
- D. River Stone: River stone shall be 1 ½" to 3" rounded and 3" to 6" rounded and oval, smooth stone, color range shall be warm tones of buff, beige, tan and gray. Color range shall be consistent throughout. Stone shall be clean and washed free of deleterious material. Contractor to submit 5 gallon container sample for each size range with source indicated.
- E. Rip-rap: rip-rap shall be sound, durable rock which is angular in shape in accordance with M2.02.0 of the State Specifications.

## 2.12 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored as follows:
- B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:
  - 1. Red: Electric.
  - 2. Yellow: Gas, oil, steam, and dangerous materials.
  - 3. Orange: Telephone and other communications.
  - 4. Blue: Water systems.
  - 5. Green: Sewer systems.

## PART 3 – EXECUTION

### 3.1 GENERAL

- A. Prior to commencing work, the Contractor shall establish property line locations and place construction control markers clearly visible and understandable to workers in the field. The Contractor shall exercise due care so as not to disturb adjacent structures and shall leave the Site in clean and orderly condition upon completion of the work.
- B. Unanticipated Soil Conditions:
  - 1. If unsuitable bearing materials are encountered at the specified subgrade depths, the Contractor shall notify the Owner. The Contractor shall carry excavation deeper and replace the excavated material with suitable compacted fill or concrete as directed by the Owner or geotechnical engineer.
  - 2. Removal of such material and its replacement as directed will be paid an extra compensation in quantity approved by the Owner. Only changes in the work authorize in advance by the Owner in writing shall constitute an adjustment in the Contract Price.
  - 3. Material that is above or below optimum moisture for compaction of the particular material in place as determined by the Owner or the Soils Representative and is disturbed by the Contractor during construction

operations so that proper compaction cannot be reached shall not be construed as unsuitable bearing materials. This material shall be removed and replaced with lean concrete or compacted Gravel Borrow as directed by the Owner or Soils Representative at no additional cost to the Owner.

4. The Contractor shall follow a construction procedure which permits visual identification of firm natural ground.
- C. Excessive Excavation: If any part of the general or trench excavation is carried, through error, beyond the depth and dimensions indicated on the Drawings or called for in the Specifications, the Contractor at his own expense, shall furnish and install compacted gravel fill, concrete, or take other remedial measures as directed by the Owner to bring fill material up to the required level or dimension.
- D. The Contractor shall reuse on-site all on-site excavated soils that meet the gradation requirements of materials specified herein. Solid waste consisting of brick, concrete, asphalt, cobbles, boulders, and all unsuitable excavated materials shall become the property of the Contractor and be legally disposed of off-site at no additional cost to the Owner. Excavated on-site soils which are suitable for re-use at the time of excavation but become frozen or too wet for re-use due to poor material handling practices shall be disposed of off-site and replaced as necessary at no additional cost to the Owner. Samples and Testing:
  1. Excavated material taken directly from on-site cuts that will meet the Specifications may be used as fill provided the Contractor obtains written approval from the Owner. No such fill material shall be put in place until approved for use by the Owner in writing. Sand Gravel Fill is not anticipated to be found on the site.
  2. Testing of materials as delivered may be made from time to time. Materials in question may not be used, pending test results. Tests of compacted materials will be made regularly. Remove rejected materials and replace with new, whether in stockpiles or in place.
- E. Deficiency of Fill Material: Provide required additional fill material to complete the work if a sufficient quantity of suitable material is not available from the required excavation on the project site at no additional cost to the Owner.
- F. Surplus Fill Material: Surplus fill that is not required to fulfill the requirements of the Contract shall be removed from the site and legally disposed of.
- G. Protect all benchmarks, monuments, and property boundary pins. Replace if destroyed by contractor's operation.

### 3.2 PREPARATION

- A. The Contractor shall be deemed to have inspected the Site and satisfied himself/herself as to actual grades and levels and true conditions under which the Work will be performed.
- B. Areas required for execution of Work shall be cleared. The work area shall be free of standing water and shall be dry.
- C. All site health and safety controls shall be fully established and in operation prior to beginning any demolition, soil, and fill excavation. Site controls shall include but not be limited to work zones properly barricaded, wheel wash and decontamination

facilities, and all support equipment and supplies including personal protective equipment. All site controls shall be reviewed by the Owner in the field.

- D. The Contractor shall provide all layout field data, including ties, to the Owner. The Contractor shall maintain all required field controls throughout the performance of the Work.
- E. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- F. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Section 31 10 00 Site and Preparation Clearing."
- G. Protect and maintain erosion and sedimentation controls, which are specified in Division 31 Section 31 10 00," during earthwork operations.
- H. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

### 3.3 REUSE OF ONSITE MATERIALS AND PROCESSING OF ONSITE MATERIALS

- A. The Contractor may re-use onsite excavated soils that meet the gradation requirements of materials specified herein.
- B. The Contractor may use a crusher onsite and to blend and crush blasted rock, boulders, and overburden soils to produce materials that meet the gradation requirements specified herein for reuse onsite.
- C. Solid waste consisting of brick (brick is not from building demolition), concrete, asphalt, cobbles and boulders that measure less than 3 cubic yards in volume shall become the property of the Contractor and be legally disposed of off-site at no additional cost to the Owner.
- D. Excavated onsite soils which are suitable for re-use at the time of excavation but become frozen or too wet for re-use due to poor material handling practices shall be disposed of off-site and replaced as necessary at no additional cost to the Owner.
- E. The Contractor must inspect all existing stockpiles on site including soil testing for each stockpiled material.
- F. The Contractor must amend the existing stockpiles if testing determines that the stockpiles do not meet the specifications for their intended use. The Contractor shall provide third party sampling and testing for all soils amended on-site.
- G. Excavation material free of organic matter and approved for reuse by the environmental professional can be placed in paved areas at depths greater than 3 feet from the bottom of the subbase layer provided that the maximum particle size is less than 2/3 of the lift thickness and that the material is compacted to a minimum relative compaction of 95 percent.
- H. The Contractor is cautioned that the onsite materials are high in fines, Materials with high fines contents are typically difficult to handle when wet as they are sensitive to

moisture content variations. Subgrade support capacities may deteriorate when such soils become wet and/or disturbed. The contractor shall keep exposed subgrades properly drained and free of ponded water. Subgrades shall be protected from machine and foot traffic to reduce disturbance. Placed onsite material that become soft and unsuitable to support additional lifts of fill shall be removed and replaced at no additional cost to the owner.

- I. The Contractor shall be allowed to mobilize a rock crusher to the site to process boulders, blasted rock, and imported rock by blending these materials with the existing fill and natural soil and crushing them to produce a well graded materials, provided that these materials are maintained at suitable moisture contents for proper compaction. Processed material obtained by crushing blasted rock, boulders, and soil shall meet the gradation requirements of Ordinary Fill and Structural Fill. Material produced by the crushing operation shall be well graded so as to reduce the potential for formation of honeycombs during its placement and compaction.
- J. Re-use of Unprocessed Material: The contractor shall be allowed to use unprocessed material in deep fill areas within the proposed paved areas if the following recommendations are followed:
  - 1. Large particles (larger than 2/3 of lift thickness) shall be culled out or screened.
  - 2. Unprocessed materials shall not be used within 3 feet of the bottom if the subbase of parking lots.
  - 3. Unprocessed materials shall not be used within the proposed building footprint.
  - 4. Unprocessed materials shall not be used during wet weather or when they are wet.
- K. The contractor shall protect stockpiled unprocessed materials from exposure to moisture using tarps. The tarps shall be secured so as not to be moved by wind or other action.
- L. When processing the blasted rock, the Contractor shall mix the blasted rock with onsite soil, including subsoil that is free of organics to produce a well graded processed material.
- M. Before blasted rock that is crushed and processed onsite is reused, it shall be observed and approved by the geotechnical engineer. The soil to rock proportions placed into the crusher shall be varied until the processed material meets the appropriate gradation requirements. The soil to rock proportion thus achieved shall be maintained throughout the duration of the project.
- N. The material placed into the crusher shall be free of organics, wood, and other deleterious matter.
- O. The jaws of the crusher shall be adjusted periodically to maintain the crushing gradation.
- P. Excess blasted rock, processed or unprocessed, not used on site shall be the property of the Contractor and shall be removed offsite at no additional cost to the Owner.

#### 3.4 EXCAVATION, GENERAL

- A. The Contractor shall remain responsible for adequacy and safety of construction means, methods and techniques.
- B. The Contractor shall complete all excavations regardless of the type, nature or condition of the material encountered. The Contractor shall be solely responsible for making all excavations in a safe manner.

- C. The Owner shall be notified of unexpected subsurface conditions. Work shall be discontinued in affected areas until notified to resume work by the Owner.
- D. Displaced or loose soil shall be prevented from falling into any excavation. The stability of soil slopes shall be maintained in accordance with applicable local, state and federal regulations and guidelines.
- E. All loose material shall be removed from the bottom of the excavation so that the bottom shall be in an undisturbed condition. If removal of the loose material results in excavation beyond the work limits and over excavation has not been approved by the Owner; the restoration of the excavation to grade shall be done at no additional cost to the Owner.
- F. When the bottom of the excavation shall, by error of the Contractor, have been taken to a depth greater than the depth specified, or directed by the Owner, said condition shall be corrected by refilling to the proper grade with granular fill or the design shall be altered in a fashion acceptable to the Owner to compensate for said error. All measures taken to rectify conditions caused by over excavation shall have the Owner's approval, and any increase in cost resulting from such measures shall be borne by the Contractor.
- G. Excavation shall not be performed when weather conditions or the conditions of the materials are such that, in the opinion of the Owner, work cannot be performed satisfactorily.
- H. Appropriate measures shall be provided to retain excavation sidewalls and to ensure that persons working in or near the excavation are protected. Sheet piling shoring or bracing may be used to support the walls of excavations. Method, design, construction and adequacy of any required bracing shall meet the OSHA requirements of 29 CFR Part 1926 and are the responsibility of the Contractor.
- I. All damage related to or caused by the excavation shall be repaired at the expense of the Contractor.
- J. Unclassified Excavation - For the purposes of payment, materials shall be unclassified except for those beyond the greater of the lines and grades shown in the Drawings and the limits specified herein (item 3.6.K). Unclassified excavation shall comprise and include the satisfactory excavation, removal, and disposal of all materials encountered within the lines and grades shown in the Drawings or limits specified in item 3.6K, whichever is deeper, regardless of the nature of the materials, and shall be understood to include, but not be limited to, earth, forest mat, topsoil, subsoil, hardpan, fill, buried organic soil, buried subsoil, foundations, pavements, curbs, piping, railroad track and ties, cobblestones, footings, bricks, concrete, abandoned drainage and utility structures, debris, and materials classified as unsuitable materials. All excavation and replacement, if applicable, with suitable material within the lines and grades shown in the Drawings or the limits specified in item 3.6K, whichever is deeper, will be considered and bid as unclassified and shall be included in the Contractor's lump sum (i.e., shall not be paid for using Unit Prices).
- K. For bidding purposes, the limits of unclassified excavation to remove the existing fill and organic soil within the building and placement of suitable backfill shall be 12 inches beneath the bottom of the slab, 6 inches beneath the bottom of the footings, 12 inches laterally outside the outer edge of footings and 3 feet laterally from the outer edge of perimeter walls. The removal of forest mat, topsoil, subsoil, and existing fill in paved areas shall be in accordance with item 3.3.B.



- L. Removal of unsuitable material beyond the grades and lines shown on the Drawings and specified in item 3.6K and its replacement, if applicable, as directed will be paid on the basis of contract conditions relative to changes in work or as provided for under the unit rates for respective classification in accordance with the allowance included in the contract documents.
- M. Should quantities of certain materials or classes of work be increased or decreased from what is shown in the drawings and specified herein, the Contract Unit Rates listed below shall be the basis of payment to the Contractor, or credit to the Owner, for such increase or decrease in the work. The Contract Unit Rates shall represent the exact net amount, per unit, to be paid to the Contractor in the case of increases in the quantities, and the exact amount to be refunded to the Owner in the case of decreases in the quantities. No additional adjustment shall be allowed for overhead, profit, insurance, or other direct or indirect expenses by the Contractor. Contract Unit Rates of materials shall include hauling, storing, stockpiling, moving, importing, spreading, and compacting. Increases or decreases in the quantities shall be approved by the Owner.
- N. The Contractor shall excavate soil and fill to the limits necessary to achieve the required grades determined by the Owner. The limits of excavation may not coincide with those areas indicated on the Drawings. The excavation areas shown on the Drawings are estimated areas only.
- O. If unanticipated bearing soils are encountered beyond the limits of excavation as specified on the Drawings and in the Specifications and at the specified subgrade depth, the Contractor shall notify the Owner's Representative in writing. The Contractor shall carry the excavation deeper and replace the excavated material with appropriate specified material or concrete as directed by the Owner or Engineer.

### 3.5 ROCK EXCAVATION

- A. Definitions and Classifications: The following classifications of excavation will be made only when rock excavation is required.
  - 1. "Earth Excavation" consists of removal and disposal of pavement and other obstructions visible on ground surface, underground structures and utilities indicated to be demolished and removed, material of any classification indicated in data on subsurface conditions, and other materials encountered that are not classified as rock excavation.
  - 2. "Rock Excavation" consists of removal and disposal of materials encountered that cannot be excavated without continuous and systematic drilling and blasting or continuous use of a ripper or other special equipment, except such materials that are classed as earth excavation. Typical of materials classified as rock excavation are as follows:
    - a. Rock or stone in original ledge.
    - b. Hard shale in original ledge.
    - c. Boulders on site, outside trench limits, exceeding three cubic yards in volume.
    - d. Boulders within trench limits, exceeding one cubic yard in volume.
  - 3. Should highly fractured or weathered bedrock be encountered during excavation, the following shall apply:
    - a. When the material is encountered in trenching operations or under footings, it shall be excavated or ripped with a hydraulic backhoe equal to or larger

than Caterpillar 325 excavator equipped with a ripping tool, and will be classified as Earth Excavation. When it is demonstrated to the satisfaction of the Owner and the Soils Representative that this material can no longer be removed with a hydraulic backhoe and requires drilling and blasting, this material shall be classified as Rock Excavation. For excavation procedures when this material is encountered under footings, refer to paragraph below.

- b. When this material is encountered in open excavation, it shall be classified as earth excavation until drilling and blasting or continuous ripping is necessary as defined hereinabove.
  4. Intermittent drilling and ripping performed to increase production and not necessary to permit excavation of material encountered will be classified as earth excavation.
  5. Allowance for Rock Excavation: The Contractor shall carry in the Base Bid an allowance for 5 cubic yards of rock encountered in trench excavation removed from the site. The Contractor shall also carry in the Base Bid an allowance of 0 cubic yards of open rock excavation removed from the site. The Base Bid shall cover all costs relating to such rock excavation, including blasting, removal and placement of the excavated material, overhead and profit. No amount other than that herein specified will be paid by the Owner for excavation herein defined.
    - a. If the total quantity of Rock Excavation, open and/or trench, exceeds the amount of Rock Excavation included in the Contract as listed above, the Owner shall pay the excess excavation at the fixed unit price of \_\_\_\_\_ per cubic yard. Quantities shall be measured by the volume of void created using survey points of the excavated area. The fixed unit price shall be applicable to variations in excess of the allowance quantity up to 100% of the allowance quantity.
    - b. If the total quantity of Rock Excavation, open and/or trench, is less than the amount of Rock Excavation included in the Contract as listed above, the Contract sum will be decreased by the difference in Rock Excavation multiplied at the fixed unit price of \_\_\_\_\_ per cubic yard. Quantities shall be measured by the volume of void created using survey points of the excavated area. The fixed unit price shall be applicable to variations of the allowance quantity by decreases of 100% of the allowance quantity.
- B. Measurements:
1. When, during the process of excavation, rock is encountered, such material shall be uncovered and exposed in such a manner that the unbroken ledge surface is clearly visible, and the Owner shall be notified by the Contractor, before proceeding further. The areas in question shall then be cross-sectioned as hereinafter specified.
  2. The contractor shall perform probes to determine the top of rock. The probes shall extend at least 5 feet into the rock to confirm rock versus a boulder.
  3. Failure on the part of the Contractor to uncover such material and to notify the Owner and proceeding by the Contractor with the rock excavation before

- cross-sections are taken, will forfeit the Contractor's right of claim towards the stated allowance or additional payment over and above the stated allowance at the quoted unit price.
4. The Contractor shall employ and pay for a Professional Civil Engineer or Land Surveyor registered in the Commonwealth of Massachusetts to take cross-sections of rock before removal and to make computations of volume of rock encountered within the Payment Lines. Cross-sections shall be taken in the presence of the Soils Representative and the computations approved by the Owner. The Owner has the option to perform independent cross-sections and computation of rock quantities.
  5. Where removal of boulder or ledge is required outside the established payment lines, the extent of this removal and basis of payment shall be determined by the Owner.
- C. Prepared rock subgrades shall be compacted with at least four passes of a self-propelled vibratory roller such as Dyna Pac CA-30D (44,000 lbs. Centrifugal force) or equivalent. Rock subgrades in utility trenches shall be recompacted with at least four passes a walk-behind vibratory drum roller or other equivalent equipment having at least 10,000 pounds centrifugal force and sufficient to provide a firm, stable subgrade.
- D. If any part of the rock excavation at footings to be carried beyond the depth and the dimensions indicated on the Drawings or called for in the Specifications, the Contractor shall, at his own expense, furnish and install concrete of same strength as footings to the required subgrade level of the footings as shown on the Drawings. Dowelling or other corrective structural measures as directed by the Owner may also be required to properly anchor or reinforce the concrete. If rock excavation is carried beyond the depth and dimensions to subgrade in other areas, the Contractor shall, at his own expense, furnish and install compacted gravel fill to subgrade as directed by the Owner.
- E. Basis of Payment: The total amount of rock excavation will be based upon the in-situ volume of rock excavated within and/or above the lines referred to in the next paragraph as "Payment Lines". The payment lines are only to be used as a basis of payment, and are not to be used as limits of excavation. Limits of excavation area as shown on the Drawings and as specified herein.
- F. Payment Lines for Rock Excavation:
1. Payment lines for columns and footings shall be a vertical line one-foot off the edge of the footings; the depth shall be measured at 12 inches below the bottom elevations shown on the Drawings. Payment lines for walls to be damp-proofed shall be a vertical line three feet outside the walls. Vertical payment lines shall be as specified hereinafter.
  2. Payment lines for manholes and catch basins shall be one-foot outside of the outer wall and 12 inches below subgrade beneath the structure.
  3. Payment lines for rock excavation under slabs on grade shall be 18 inches below the bottom of the slab. Payment lines for rock excavation at plant beds shall be 12" at edge and full depth of required elevation for loam.
  4. Payment lines for rock excavation at paved areas and lawns shall be 18 inches below bottom of asphalts.
  5. Payment lines for rock excavation under pipes within the building and for utility trenches outside the building lines shall in no case be calculated as greater in

width than the outside diameter of the pipe plus two feet for pipes up to 18 inches. For pipes 18 inches and larger payment lines shall in no case be calculated as greater in width than the outside diameter of the pipe plus three feet. Payment lines at bottom of all pipe and utility trenches shall be 12 inches below the bottom of the pipe.

### 3.6 STORAGE OF SOIL MATERIALS - STOCKPILING

- A. The Contractor shall be responsible for managing and tracking any and all materials excavated and placed in stockpiles for testing.
- B. Materials shall be stockpiled on site at locations proposed by the Contractor and approved by the Owner. Stockpiled materials shall be of sufficient quantities to meet project schedule and requirements
- C. Tracking of the stockpiles shall be performed in accordance with the approved Work Plan submitted by the Contractor in accordance with Section 01 33 00.
- D. The temporary stockpiled fill must be removed from the Site in accordance with applicable regulatory deadlines however no later than the completion date of this contract or 90 days from the date the stockpile was created, whichever is encountered first.
- E. Stockpiles shall be securely barricaded and clearly labeled. Differing materials shall be separated with dividers or stockpiled apart to prevent mixing.
- F. The Contractor shall direct surface water away from stockpile site to prevent erosion or deterioration of materials. Soils shall be suitably dewatered prior to their relocation on Site or disposal off site.
- G. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

### 3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
- B. Trenches shall be excavated to the necessary width and depth for proper laying of pipe or other utility and excavation side slopes shall conform to OSHA requirements. Minimum width of trenches shall provide clearance between the sides of the trench and the outside face of the utility. Maximum trench sizes are as shown on the Drawings or as specified herein. The depth of the trench shall be twelve inches below the bottom of the pipe barrel or respective utility. If the existing soil at the final subgrade excavation is found not suitable, the Owner or Soils Representative may approve removal and replacement of material.
  - 1. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to

12 inches (300 mm) higher than top of pipe or conduit, unless otherwise indicated.

2. Clearance: As indicated on plans.
  3. For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
  4. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- C. The Contractor shall provide, at his own expense, suitable bridges over trenches where required for accommodation and safety of the traveling public and as necessary to satisfy the required permits and codes.

### 3.8 SUBGRADE INSPECTION, COMPACTION AND PROOF ROLLING

- A. Notify Owner when excavations have reached required subgrade.
- B. Proof compact all subgrades in accordance with Subsection 3.3 of this Specification Section to identify soft pockets and areas of excess yielding. Do not proof compact wet or saturated subgrades.
1. Completely proof compact subgrade in one direction repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).
  2. Revise minimum weight or type of vehicle in first subparagraph below if required.
  3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Owner and/or Soil Representative, and replace with compacted fill as directed.
  4. Proof compacting shall be completed utilizing a 20-Ton vibratory drum roller for granular soils. Should clay or other cohesive soils be encountered, sheep's foot roller shall be utilized. A total of 6 passes shall be considered complete.
- C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Owner and/or soil representative, without additional compensation.

### 3.9 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
1. Construction below finish grade including, where applicable, subdrainage,
  2. Surveying locations of underground utilities for Record Documents.
  3. Testing and inspecting underground utilities.
  4. Removing concrete formwork.
  5. Removing trash and debris.
  6. Removing temporary shoring and bracing, and sheeting.
- B. If, through failure or neglect of the Contractor to conduct the excavation work in a proper manner, the surface of the subgrade is in an unsuitable condition for proceeding with construction, the Contractor shall, at his own expense, remove the unsuitable material and replace it. Failure of the Contractor to control surface or ground water adequately, premature excavation at the work site, or other

manifestations of the Contractor's neglect or improper conduct of the work, as determined by the Owner, shall be grounds for requiring removal and replacement of unsuitable subgrade without additional compensation.

- C. Grading in the vicinity of backfilling shall be properly pitched to prevent water from running into the backfilled area. Work areas shall be kept free from water during performance of the work under this Contract at no expense to the Owner. The Contractor shall build diversion berms and other devices necessary for this purpose.
- D. The Contractor shall not commence backfilling operations until the Owner gives approval.
- E. After the subgrade has been prepared, fill material shall be placed and built-up in successive layers until the required elevations are reached. No fill shall be placed on a frozen surface, nor shall snow, ice, or other frozen material be included in fill. Wet materials containing moisture in excess of the amount necessary for satisfactory placement or compaction shall not be used.
- F. All fill shall be brought up in essentially level lifts and shall be placed in levels by standard methods. The method of placement shall not disturb or damage other work. Layers of fill shall not exceed twelve inches of uncompacted thickness before compaction, unless otherwise specified or as necessary for proper subgrade stabilization.
- G. Place backfill on subgrades free of mud, frost, snow, or ice.
- H. Filling operations shall continue until the fill has been brought up to the finished slopes, lines, and grades making proper allowances for thickness of surface treatment.
- I. The entire surface of the work shall be maintained free from ruts and in a condition that will permit construction equipment to travel readily over any Section. The top surface of each layer shall be made level or slightly sloped away from the center of the filled area. Fills shall be graded to drain and compacted/sealed whenever precipitation is expected.
- J. Backfilling shall not be performed when weather conditions or the conditions of the material are such that, in the opinion of the Owner, work cannot be performed satisfactorily.

### 3.10 ACCEPTABLE BACKFILL MATERIALS

- A. Backfill materials shall be placed in the areas as indicated in the table below:

Fill at depths greater than 1-foot below footings and slabs within the Building Area	Structural Fill
Fill around footings for building and structures within the Influence Area	Structural Fill
Fill below pavement subbase	Ordinary Fill
Fill below sidewalk subbase	Ordinary Fill

Fill placed in top 1 foot below sidewalks	Select Fill
Fill within utility trenches below pavement and sidewalk subgrade	Granular Fill
Fill below utility bedding	Granular Fill
Fill placed 6 inches below footings	Structural Fill
Fill placed 1 foot below slabs	Structural Fill
Fill placed in landscaped areas outside of the Influence Area of footings, retaining walls, and slopes	Common Borrow

### 3.11 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Place and compact initial backfill material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.
  1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- D. Backfill voids with satisfactory soil while installing and removing shoring and bracing.
- E. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- F. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

### 3.12 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
  - i. Sequentially place and compact fill material in layers to required elevations.
- B. Place soil fill on subgrades free of mud, frost, snow, or ice.

### 3.13 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
  1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.

2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by +2 to -3 percent and is too wet to compact to specified dry unit weight.
3. If in the opinion of the Owner, additional moisture is required, water shall be applied by sprinkler tanks or other uniform distribution devices. If excessive amounts of water or if rain should cause excessive wetness, the area shall be allowed to dry as provided above.

### 3.14 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross Sections, lines, and elevations indicated. Grading shall be done by standard methods. Areas adjacent to structures and other areas inaccessible to heavy grading equipment shall be graded by manual methods. Embankments shall be graded at all times to ensure runoff of water.
  1. Provide a smooth transition between adjacent existing grades and new grades.
  2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
  3. Provide proper drainage from the site, no grading shall be done to direct water to damage or potentially damage adjacent property or work executed under this contract.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
  1. Lawn or Unpaved Areas: Plus or minus [**1 inch**]
  2. Walks: Plus or minus [**1 inch**]
  3. Pavements: Plus or minus [**1/2 inch**]

### 3.15 FIELD QUALITY CONTROL

- A. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- B. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed in accordance with Subsection 1.7 of this Specification Section and:
  1. Paved Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every **500 sq. ft.** or less of paved area, but in no case fewer than 3 tests.
  2. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each **150 feet** or less of trench length, but no fewer than 2 tests.
- C. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.



### 3.16 COMPACTION REQUIREMENTS

- A. The following table lists minimum compactive efforts, which are required for all, fill materials. Compaction of each lift shall be completed before placement and compaction of the next lift is started. The compaction equipment shall make an equal numbers of transverse and longitudinal coverages of each lift. The degree of compaction for fill placed in various areas shall be as follows:
- |                                       |     |
|---------------------------------------|-----|
| 1. In paved areas                     |     |
| Within aggregate base course          | 95% |
| Within aggregate subbase course       | 95% |
| Below subbase course                  | 95% |
| 2. In landscaped areas                | 92% |
| 3. Around and Above Utilities below   |     |
| Below Pavement subbase in paved areas | 95% |
- C. Compaction shall be accomplished by vibratory rollers, multiple wheel pneumatic tired rollers or other types of approved compacting equipment. Loaded trucks, low beds, water wagons and the like shall not be considered as acceptable compaction equipment unless specifically approved by the Owner for a particular location. Equipment shall be of any such design that it will be able to compact the fill to the specified density in a reasonable length of time. All compaction equipment shall be subject to the approval of the Owner.
- D. The Contractor shall compact all fills made during the day of work prior to leaving the project for the evening. The upper layer shall be pitched as necessary to provide positive drainage towards swales or interceptor ditches to minimize ponding and erosion should it rain.

### 3.17 COMPACTION TESTING

- A. The Contractor shall make all necessary excavations and preparations for testing. Excavations for density tests shall be backfilled with material similar to that excavated, and compacted to the specified density by the Contractor. Failure of the backfill material to achieve the specified density will be just cause for rejection of any or all portions of the excavation Section tested. The Contractor will not be granted an extension of time or additional compensation for testing or repair of backfill ordered by the Owner.
- B. Field density tests will be made by the Owner's Inspection Agency in accordance with the Method of Test for ASTM Designation D1556 or D6938, to determine adequacy of compaction; the location and frequency of such field tests shall be at the Owner's Inspection Agency's discretion.
- C. All field density tests results shall be reviewed by the Owner prior to the placement of concrete.
- D. The Contractor shall notify the Inspection Agency when an area is ready for compaction testing. This notification shall be 48 hours in advance of placing or final compaction so that the Owner Inspection Agency has adequate time to take compaction tests.

- E. Cooperate with the Owner in obtaining field samples of in-place materials after compaction. Furnish incidental field labor in connection with these tests. The Contractor will be informed by the Owner of areas of unsatisfactory density which may require improvements by removal and replacement, or by scarifying, aerating, sprinkling (as needed), and recompaction prior to the placement of the new lift. No additional compensation shall be paid for work required to achieve proper compaction.
- F. The Owner or Owner's Inspection Agency's presence does not include supervision or direction of the actual work by the Contractor, his employees, or agents. Neither the presence of the Inspection Agency nor any observations and testing performed by him shall excuse the Contractor from defects discovered in his work.

### 3.18 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
  - 1. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
- B. Scarify or remove and replace soil material to depth as directed by Owner; reshape and recompact.
  - 1. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
  - 2. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

### 3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Project property.

### 3.20 REMOVAL OF EROSION CONTROL MEASURES

- A. Remove temporary drainage swales, check dams, siltation sumps, hay bales, siltation fencing and other temporary drainage, erosion and siltation control measures when permanent drainage control measures have been installed and grass is established in drainage areas leading to siltation sumps. Contractor shall excavate and remove all sediments from siltation sumps prior to backfilling the sumps. Remove erosion control measures when approved by the Owner.

End of Section

31 10 00

SITE PREPARATION

**PART 1 - GENERAL**

**1.01 GENERAL PROVISIONS**

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 – GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.
- B. Examine all other Sections of the Specifications and drawings for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section or implied on the drawings.
- C. Coordinate work with trades affecting, or affected by, work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.
- D. All work shall conform to the Town of Northbridge Department of Public Works (DPW) Standards.

**1.02 WORK INCLUDED**

- A. Provide all labor, materials, equipment, services, and transportation required to complete all site preparation work as shown on the Drawings, as specified herein, or both.
- B. Include the following work:
  - 1. Removing asphalt pavement and base.
  - 2. Removing curbs, and base.
  - 3. Removing designated site improvements.
  - 4. Removal of topsoil.
  - 5. Removal of Concrete wall.
  - 6. Clearing and grubbing.
- C. See Drawings for locations and details.

**1.03 RELATED WORK**

- A. Section 31 25 00 EROSION AND SEDIMENTATION CONTROLS

**1.04 PERMITS AND CODES**

- A. All work shall comply with applicable codes, ordinances, rules, regulations, and laws of all local, state, and federal authorities having jurisdiction. All work necessary to make site preparation comply with such requirements shall be provided without additional cost to the Owner.
- B. Contractor shall procure and pay for all permits and licenses required for work under this Section and shall give all required notices.
- C. Do not close or obstruct any streets, sidewalks, alleys, or passageways unless and until they have been discontinued by the appropriate municipal authority, or unless

and until all necessary municipal and other permits have been secured. No materials whatsoever shall be placed or stored in streets, alleys, or passageways until they have been so discontinued. Conduct all operations to interfere as little as possible with the use ordinarily made of roads, driveways, alleys, sidewalks, and other facilities near enough to the work to be affected.

#### 1.05 PROJECT CONDITIONS

- A. Contractor shall locate, protect, and maintain benchmarks, monuments, control points, and project engineering reference points. Disturbed or destroyed items shall be re-established at no additional cost to the Owner.
- B. Perform site work operations and the removal of debris and waste materials to assure minimum interference with streets, walks, and other adjacent facilities.
- C. Obtain governing authorities' written permission when required to close or obstruct streets, walks, and adjacent facilities. Provide alternate routes around closed or obstructed traffic ways when required by governing authorities.
- D. Control dust caused by the work. Dampen surfaces as required. Comply with pollution control regulations of governing authorities.
- E. Protect existing buildings, paving, and other services or facilities on site and adjacent to the site from damage caused by site work operations. Cost of repair and restoration of damaged items shall be at no additional cost to the Owner.
- F. Protect and maintain streetlights, utility poles and services, valves and other services, except items designated for removal. Remove or coordinate the removal of traffic signs and postal mailboxes, etc. with the applicable governmental agency. Provide for temporary relocation when required to maintain facilities and services in operation during construction work.
- G. Adjust rim elevations on utility access structures to remain, such as manholes and cleanouts, to be flush with new grade elevations unless otherwise indicated on the Drawings.
- H. When uncharted or incorrectly charted underground piping or other utilities and services are encountered during site work operations, notify the applicable utility company immediately to obtain procedure directions. Cooperate with the applicable utility company in maintaining active services in operation.
- I. Do not commence site clearing operations until temporary erosion and sedimentation control and tree protection measures are in place.
- J. Perform soil stripping, handling, and stockpiling only when topsoil is dry or slightly moist.

#### 1.06 PREVIOUS SITE PREPARATION

- A. Contractor shall accept the site as received at the commencement of this Contract, including measures taken previously to alter, protect, stabilize, and maintain site conditions.

- B. Removal and disposal of temporary provisions is included in the work of this Section. Do all additional site preparation required for construction as further provided in this Section, in accordance with the Contract documents.

## **PART 2 - PRODUCTS**

### 2.01 NOT USED

## **PART 3 - EXECUTION**

### 3.01 SITE CONDITIONS

- A. Perform site preparation work before commencing construction.
- B. Locate, protect, and maintain active utilities and site improvements to remain. Consult the records and drawings of adjacent work and of existing services and utilities which may affect site work operations.
- C. Conduct a conference on site with the Designer and Owner present to designate the work zone the limit of any protection zones.
- D. Provide necessary barricades, coverings, and protection to prevent damage to existing improvements to remain.
- E. Restore to original grades and conditions areas adjacent to the site disturbed or damaged as a result of site preparation work.
- F. Examine the areas and conditions under which site work is performed. Do not proceed with the work until unsatisfactory conditions are corrected.

### 3.02 REMOVAL OF EXISTING SITE IMPROVEMENTS

- A. Remove existing site improvements within the limit of work line as indicated. Include the following:
  - 1. Asphalt pavement
  - 2. Other indicated items
- B. Information on the Drawings relating to existing utility lines and services is from the best sources presently available. All such information is furnished only for informational purposes and is not guaranteed. Excavate test pits as required to determine exact locations of existing utilities.
- C. Coordinate with the Owner on utilities to be removed or relocated so services to other buildings remain active and uninterrupted.
- D. Remove existing paving, including base material, as required to accommodate new construction. Cut existing paving in neat, straight lines to provide uniform, even transition from new to adjacent existing work.
- E. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
  - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw cut faces vertically.

2. Paint cut ends of steel reinforcement in concrete to remain with two coats of anti-rust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.
3. Upon completion of site preparation work clean areas of work and remove tools and equipment. Provide site clear, clean, and free of materials and debris and suitable for site construction operations.

### 3.03 REMOVAL OF TREES AND SHRUBS

- A. Before commencing other work under this Section, Contractor shall provide protection for trees and shrubs which are to remain. Refer to the Drawings and arrange a conference on the site with the Designer to identify and mark trees and shrubs which are to remain, be removed, and/or be transplanted. Do no clearing without a clear understanding of existing conditions to be preserved.
- B. Exercise extreme care during excavation to prevent damage to roots of trees which are to remain. Owner shall be notified in advance of excavation within and adjacent to tree- protection zones and shall be present during the operation. When excavating or grading within the branch spread of trees to remain, do so in a manner which will cause minimum damage to root systems.

### 3.04 REMOVAL OF BITUMINOUS PAINT

- A. Existing pavement located within the limits the work shall have all pavement markings removed and disposed of.

### 3.05 STRIPPING AND STOCKPILING TOPSOIL

- A. Prior to starting general excavation, strip all topsoil within areas to be occupied by structures, pavements, steps, lawns, planting, and trenches, as well as all areas to be regraded or used for construction operations, for later use in topsoiling and finish grading. Areas for stockpiling topsoil shall receive approval from the Designer prior to being used. Should the topsoil be stockpiled in any area without prior approval of the Designer, Designer may direct Contractor to relocate such stockpile to another portion of the site, and the Contractor shall do so at no additional cost to the Owner.
- B. Do no stripping without clear understanding of existing soil, planting, and site conditions to be preserved. Topsoil shall be stripped its entire natural depth as indicated on the Drawings. Redistribution of topsoil is included as part of the work specified in other Sections. Do not remove topsoil from site without explicit written approval of Designer.
- C. Do not strip topsoil in tree-protection zones.
- D. Remove sod and grass before stripping topsoil.
- E. Carry removal of 12 in. of loam throughout the site. Removed loam shall be stockpiled, and covered on the site in areas designated for such purpose by the Designer. Areas having greater depths of loam than reasonably anticipated shall be stripped of all loam and ordinary fill shall be used to bring such areas to the rough-grade level. Sticks, stones, and roots over 2 inches in any dimension shall be removed from loam before stockpiling. All other stripped material which can be classified as fill under 31 00 00 EARTHWORK shall be used or stockpiled for re-use in rough-grading or backfill.

- F. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
- G. Surplus topsoil and fill not required to fulfill the requirements of the Contract shall become the property of the Contractor and shall be removed from the site and legally disposed of.

### 3.06 DISPOSAL OF WASTE MATERIALS

- A. Remove, haul from site, and legally dispose of all waste materials and debris not required to be saved. Accumulation is not permitted.
- B. Maintain disposal routes clear, clean, and free of debris.
- C. On-site burning of combustible cleared materials is not permitted.
- D. Contractor shall cover trucks used for hauling, follow approved routes, obtain disposal permits required and pay all fees in connection with disposal of materials removed.
- E. Upon completion of site preparation work, clean areas of work and remove tools and equipment. Provide site clear, clean, and free of materials and debris and suitable for site construction operations.

### 3.07 SALVAGEABLE MATERIALS

- A. Remove and stockpile, at the direction of the Designer, all materials indicated to be salvaged.
- B. Salvaged items shall include suitable topsoil, fill materials, and other materials indicated to be saved and/or reused.
- C. Where items are to be removed and furnished to the Owner, they shall be transported to an area identified by the Owner at no additional cost.
- D. All removed materials, items, and equipment not indicated to be saved shall be the property of the Contractor and shall be removed from the site and legally disposed of.
- E. Remove non-salvage materials from site as work progresses. Storage and sale of Contractor's salvage items on site is not permitted.
- F. Any items salvaged, but not ultimately used in the project, shall become the property of the Contractor and legally disposed of off-site.

END OF SECTION – 31 10 00

SECTION 31 25 00  
EROSION AND SEDIMENTATION CONTROLS

**PART 1 - GENERAL**

1.01 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 – GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.
- B. Examine all other Sections of the Specifications and drawings for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section or implied on the drawings.
- C. Coordinate work with trades affecting, or affected by, work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.02 SUMMARY

- A. Provide all equipment and materials and do all work necessary to construct a complete erosion and sedimentation control program for minimizing erosion and siltation during the construction phase of the project. The erosion and sediment control provisions detailed on the Drawings and specified herein are the minimum requirements for an erosion control program. The Contractor shall provide additional erosion and sedimentation control materials and methods as needed to affect the erosion and siltation control principles specified herein.

1.03 RELATED WORK

- A. Section 32 12 16 ASPHALT PAVING
- B. Section 33 10 00 WATER UTILITIES
- C. Section 33 30 00 SANITARY SEWAGE

1.04 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO): Standard Specifications for Highways and Bridges
  - M288 Geosynthetic Specification for Highway Applications
  - R69 Determination of Long-Term Strength for Geosynthetic Reinforcement
- B. American Society for Testing and Materials (ASTM):
  - D4884 Test Method for Strength of Sewn or Bonded Seams of Geotextiles
  - D6461 Silt Fence Materials
  - D6462 Silt Fence Installation and Maintenance



- C. Massachusetts Department of Transportation (MassDOT): Highway Division Standard Specifications for Highways and Bridges (MassDOT Specifications)

#### 1.05 SUBMITTALS

- A. Proposed methods, materials to be employed, and schedule for effecting erosion and siltation control and preventing erosion damage shall be submitted for approval. Submittals shall include:
  - 1. Proposed methods for affecting erosion and siltation control, including 1 in. equals 20 ft. scale plans indicating location of erosion control devices, stockpiling and storage areas, construction entrance, and concrete washout areas.
  - 2. List of proposed materials, including manufacturer's product data.
  - 3. Schedule of erosion control program indicating specific dates for implementing programs in each major area of work.
- B. The following shall be submitted:
  - 1. Geotextile Fabric Sample (Sedimentation Fence and other filter/separation fabrics) – 12 in. by 12 in. sample. The brand name shall be labeled on the fabric or the fabric container.
  - 2. Straw Wattles

#### 1.06 EROSION CONTROL PRINCIPLES

- A. The Contractor shall implement all soil erosion and sedimentation control devices prior to any earth moving within the site.
- B. The following erosion control principles shall apply to the land grading and construction phases:
  - 1. Stripping of vegetation, grading, or other soil disturbance shall be done in a manner which will minimize soil erosion.
  - 2. Whenever feasible, natural vegetation shall be retained and protected.
  - 3. Limit extent of area which is exposed and free of vegetation to the smallest extent practical. In addition, duration of exposure shall be kept to a minimum.
  - 4. Drainage provisions shall accommodate increased runoff resulting from modifications of soil and surface conditions during and after development or disturbance. Such provisions shall be in addition to existing requirements.
  - 5. Sediment shall be retained on-site.
  - 6. Erosion control devices shall be installed as early as possible in the construction sequence prior to the start of clearing and grubbing operations and excavation work.
- C. Stockpiled materials shall be protected to prevent erosion. Slopes shall be protected with permanent erosion protection when erosion exposure period is expected to be greater than or equal to six months, and temporary erosion protection when erosion exposure period is expected to be less than six months.
  - 1. Temporary erosion protection shall be accomplished by covering with erosion protection materials, as appropriate for the prevailing conditions.
  - 2. Permanent erosion protection shall be accomplished by seeding with grass and covering with an erosion protection material, as appropriate for prevailing conditions.
- D. Note that shallow surficial slope failures and/or surficial erosion could occur locally if sufficient vegetation (i.e. grass or other plantings) is not established on the proposed slopes. Erosion control material, such as Flexterra HP-FGM, should be applied to the slopes if they will be left unplanted for an extended period of time. Topsoil should be placed in loose layers no greater than 6 inches in thickness which are compacted to an approximate 4-inch thickness. If sod is placed, it should be placed horizontally across the

slope with a minimum stagger of 1/3rd of the sod roll. Sod should be rolled after placement and staked through the topsoil layer into the underlying fill or glacial soil.

- E. Groundwater break-out through the slope or surface water runoff could also cause local areas of slope instability which could be addressed on a case-by-case basis. To reduce the amount of surface water runoff, a collection trench could be constructed parallel to the top of the slope and consist of an approximate 1-foot wide by 2-foot deep trench that is encapsulated with filter fabric and backfilled with ¾-inch crushed stone. A 6-inch diameter PVC pipe would be placed in the trench which would be directed to a storm drain.

#### 1.07 INSPECTION

- A. Upon installation of all soil erosion and sedimentation control devices, the Contractor shall notify and coordinate a site inspection with the Designer.

### PART 2 - PRODUCTS

#### 2.01 TEMPORARY SEED COVER

- A. Grass seed for temporary seed cover shall be a mixture of the previous year's crop. It shall contain the following mixture by weight with 98 percent purity:

Seed Type	% by Weight	Germination Minimum %
Winter Rye	80 minimum	85
Red Fescue (Creeping)	5 minimum	80
Perennial Rye Grass	5 minimum	90
Dutch White Clover	3 minimum	90
Other Crop Grass	0.5 maximum	
Noxious Weed Seed	0.5 maximum	
Inert Matter	1.0 maximum	

- B. Seed shall be delivered to the site in sealed containers, labeled with the name of the seed grower and seed formula. Seed shall be dry and free of mold.
- C. A manufacturer's certificate of compliance will be required as specified in MassDOT Specifications M6.03.0.

#### 2.02 HYDRAULICALLY APPLIED EROSION CONTROL

- A. Erosion control products such as FlexTerra HP-FGM or approved equal may be used in place of standard hydroseeding.
- B. All components shall be pre-packaged by the manufacturer. No chemical additives, soil neutralizers, and bio-stimulant materials shall be added to this product, with the exception of fertilizer.
- C. Manufacturer shall submit a letter of certification that the product meets or exceeds all technical and packaging requirements and is made in the U.S.A.
- D. Materials shall be delivered to site in UV and weather-resistant factory labeled packages and shall be stored and handled in strict compliance with manufacturer's instructions and recommendations. Protect from damage, weather, excessive temperatures, and construction operations.

2.03 SILT FENCE

- A. The geotextile fabric shall be woven or nonwoven fabric consisting of only long chain polymeric filaments or yarns, such as polypropylene, polyethylene, polyester, polyamide, or polyvinylidene-chloride formed into a stable network such that the filaments or yarns retain their relative position to each other. The fabric shall be inert to commonly encountered chemicals and free of defects or flaws which significantly affect its physical and/or filtering properties. Fabric shall conform to ASTM D6461 and the relevant sections of AASHTO M288.
- B. During all periods of shipment and storage, the fabric shall be wrapped in a heavy-duty protective covering to protect the fabric from direct sunlight, UV rays, temperatures greater than 140°F, mud, dirt, dust, and debris.
- C. Support fence posts shall be at least 48 in. high (extending 2 ft. above normal water line while being driven to sufficient depth to provide stable support for fence) and strong enough to support applied loads.
- D. Posts shall be wood or steel, at the Contractor's option. Wood posts shall consist of sound quality hardwood with a minimum cross-sectional area of 3 sq. in. Steel posts shall be standard "T" or "U" shape and shall weigh at least 1.33 pounds per linear foot.
- E. Fabric shall be attached to the posts with prefabricated pockets in the fabric, staples, or other suitable arrangements which have received approval from the Designer.
- F. Prefabricated fence systems may be used, provided they meet all of the above material requirements. Filter fabric shall be similar to those given below.

Product (Woven)	Product (Nonwoven)	Manufacturer
Mirafi 500X	Mirafi 140NL	TenCate Geosynthetics 365 South Holland Drive Pendergrass, Georgia 30567 706-693-2226 <a href="https://www.tencategeo.us/en-us/">https://www.tencategeo.us/en-us/</a>
GeoTex 2130	GeoTex 351	Propex 4019 Industry Drive Chattanooga, TN 37416 800-621-1273 <a href="http://propexglobal.com/">http://propexglobal.com/</a>
US 200	US 90NW	US Fabrics 3904 Virginia Ave Cincinnati, OH 45227 800-518-2290 <a href="https://www.usfabricsinc.com/">https://www.usfabricsinc.com/</a>

## 2.04 CATCH BASIN FILTERS

- A. Catch basin filters shall be manufactured from a specially designed woven polypropylene geotextile and sewn by a double needle machine, using a high strength nylon thread. Seams shall have a certified average wide width strength of 165.0 lbs./in. per ASTM D4884.
- B. The filters shall be manufactured to fit the opening of the catch basin or drop inlet. The filters shall have the following features: two dump straps attached at the bottom to facilitate the emptying of the filters; lifting loops to be used to lift the filters from the basin as an integral part of the system; a restraint cord approximately halfway up the sack to keep the sides away from the catch basin walls and to act as a visual means of indicating when the sack should be emptied.
- C. Catch basin filter geotextile fabric shall have the following properties:

Property (units)	Minimum Value	Test Method
Grab Tensile (lbs)	300	ASTM D4632
Grab Elongation (%)	15 (20 max)	ASTM D4632
Puncture (lbs)	120	ASTM D4833
Mullen Burst (psi)	650	ASTM D3786
Trapezoid Tear (lbs)	120	ASTM D4533
UV Resistance (%)	80	ASTM D4355
Apparent Opening Size (U.S. Standard Sieve)	Hole size equal to or smaller than a U.S. Standard No. 40 (0.425 mm)	ASTM D4751
Permittivity (sec <sup>-1</sup> )	0.55	ASTM D4491
Flow Rate (gal/min/ft <sup>2</sup> )	40	ASTM D4491

## 2.05 STRAW WATTLES

- A. Straw wattle shall consist of 99.9 percent seed-free agricultural straw inside tubular non-woven photodegradable high-density polypropylene (HDPE) netting with a one year UV inhibitor. Straw wattles shall have a diameter of 9 in. to 12 in. (plus or minus 10 percent). Length shall be manufacturer's standard length.

## 2.06 EROSION CONTROL BLANKET

- A. Erosion control blankets shall be a uniform, open, plain weave cloth of undyed and unbleached single jute yarn. The yarn shall be of a loosely twisted construction and it shall not vary in thickness more than one-half its normal diameter. Jute mesh shall be furnished in rolled strips and shall meet the following requirements:
- B. Width - 48 inches, plus or minus one inch  
78 warp - ends per width of cloth (minimum)  
41 weft - ends per yard (minimum)  
Weight shall average 1.22 pounds per linear yard with a tolerance of plus or minus 5%.
- C. Staples shall be U-shaped and shall be approximately six inches long and one inch wide. Machine made staples shall be of No. 11 gauge or heavier steel wire. Handmade staples shall be made from 12-inch lengths of No. 9 gauge or heavier steel wire.

### **PART 3 - EXECUTION**

#### **3.01 STRAW WATTLES**

- A. Straw Wattles shall be installed as needed to contain silt and/or erosion within the work zone.
- B. Excavate a 4 in. rounded trench the length of the proposed wattle position. Spoils shall be thrown on the upside of the trench. Wattles shall be placed into position, ensuring that wattles are in firm contact with the soil.
- C. Wattles shall be installed such that the ends are continuously butted up to each other and zip tied. Wattles shall be staked approximately every 4 ft. Where excessive ripping occurs, wattle shall be replaced, repaired, or staked on the downhill side on both sides of the rip.
- D. Wattle system should be visually inspected on a weekly basis or after weather events with more than 0.39 in. of rain in an hour.

#### **3.02 CATCH BASIN FILTER**

- A. Catch basin filters shall be placed at all inlets to drainage structures as structures are installed and as pavement is removed. Outlet protection work shall be constructed before runoff is allowed to enter the drainage system.
- B. Construction and location of catch basin filters shall be as indicated on the Drawings.

#### **3.03 SILT FENCE**

- A. Silt fence installation shall be in the locations shown on the plans and may be supplemented with requirements of regulatory authorities issuing permits. The silt fence installation and check out shall precede any landscape disturbance.
- B. Installation of the silt fence shall be in accordance with ASTM D 6462, the manufacturer's recommendation, and the Details. Posts shall be spaced a maximum of 8 ft. apart for unsupported silt fences or for silt fence material with elongation less than 50 percent. For silt fence material with elongation greater than 50 percent and supported silt fences, the maximum post spacing is 4 ft.
- C. Excavate a 6 in. by 6 in. trench on the contour with 6 ft. at extending up slope at the ends to prevent silt laden runoff from escaping. Set the posts to the depth specified on the Drawings. Attach the fabric to the posts on the upstream side. The fabric shall extend 2 ft. above the normal water level and at least 10 in. shall extend horizontally along the soil at the bottom.
- D. Wrap the bottom 10 in. of the fabric around the inside of the trench, and then backfill the soil into the fabric pocket so as to anchor the fence fabric. Soil shall then be placed over the horizontal bottom layer of fabric to a depth of 6 in. Backfill and compact the trench with excavated soils. Use one pass with a manually directed vibratory plate for granular soils (sands and gravels) or a manually directed tamper for fine grained soils (clays and silts).
- E. Fabric may be spliced together along the vertical edge by overlapping the pieces by one post spacing or 6 ft., whichever is greater, and securing the layer together at intervals of 2 in.
- F. Should the required height exceed the roll width, a second roll shall be used. The width shall be overlapped a minimum of 1 ft. and the layers shall be secured together at not more than 2 ft. intervals along the midpoint of the overlap.

- G. Should sediment accumulate to the point where the fence will be overtopped with flow or the weight of the sediment threatens to collapse the fence, the sediment shall be removed and placed above the silt fence out of concentrated flow areas or at other approved locations.
- H. At the conclusion of construction when all vegetative actions have been completed the silt fence shall be removed and trapped silt shall be spread across established vegetation outside paths of concentrated flow. Maximum depth of spread soil shall be 4 in.

#### 3.04 TEMPORARY SEED COVER (IF REQUIRED)

- A. Grass seed shall be spread by mechanical spreader at a rate of 0.40 lb./100 sq. ft.
- B. Following seeding, area shall be lightly raked to mingle seed with the top 1/8 in. to 1/4 in. of soil. Areas shall then be smoothed and rolled.
- C. Following rolling, entire area shall be watered until equivalent of a 2 in. depth of water has been applied to entire seeded surface, at a rate which will not dislodge seed. Watering shall be repeated thereafter as frequently as needed to prevent drying of surface, until grass attains an average height of 1-1/2 in.
- D. At the Contractor's option, seed may be spread by the hydroseeding method, utilizing power equipment commonly used for that purpose. Seed and mulch shall be mixed and applied to achieve application quantities specified herein for the conventional seeding method, with mulch applied at the rate stated in the table below. An industry standard mulching machine shall be equipped to eject the thoroughly wet mulch material at a uniform rate to provide the mulch coverage specified. Other provisions specified above shall apply to hydroseeding.
  - 1. If the results of hydroseeding are unsatisfactory, the mixture and/or application rates and methods shall be modified to achieve the desired results.
  - 2. After the grass has appeared, all areas and parts of areas which fail to show a uniform stand of grass, for any reason whatsoever, shall be reseeded and such areas and parts of areas seeded repeatedly until all areas are covered with a satisfactory growth of grass.

Slope/Gradient Condition	Application Rates
≤ 3H to 1V	3000 lb./ac
> 3H to 1V and ≤ 2H to 1V	3500 lb./ac
> 2H to 1V and ≤ 1H to 1V	4000 lb./ac
> 1H to 1V	4500/ac

#### 3.05 HYDRAULICALLY APPLIED EROSION CONTROL

- A. Examine substrates and conditions where materials shall be applied. Apply products to geotechnically stable slopes that have been designed and constructed to divert runoff away from the face of the slope. Do not proceed with installation until satisfactory conditions are established.
- B. Strictly comply with manufacturer's instructions and recommendations, including soil testing, species selection, seedbed preparation, and installation.
- C. Use approved hydroseeding machines with fan-type nozzle (50-degree tip).

#### 3.06 DUST CONTROL

- A. Implement dust control measure during construction. Minimize dust clouds by watering down construction area or using other approved methods. Water used for dust control measure shall be applied using appropriate quantities and equipment. No chemical additives shall be used.

### 3.07 CONCRETE WASHOUT AREA

- A. Concrete truck shall be washed out in an area approved by the Owner. Designate wash-out areas with proper signage. Locate a concrete wash-out box near the concrete trucks to prevent concrete residue from being washed off-site. Wash-out containers can be prefabricated or constructed on-site out of plywood and plastic sheeting. All runoff from wash-out activities shall be directed to the on-site control measures. Discarded cementitious materials shall be removed and disposed of off-site.

### 3.08 MAINTENANCE AND REMOVAL OF EROSION CONTROL DEVICES

- A. Erosion control devices shall be checked in accordance with the SWPPP or as specified herein. Should requirements conflict, the SWPPP shall take precedence.
- B. Erosion control devices shall be maintained until all disturbed earth has been paved or vegetated, at which time they shall be removed. After removal, areas disturbed by these devices shall be regraded and seeded.
- C. Wetland areas, water courses, and drainage swales adjacent to construction activities shall be monitored twice each month for evidence of silt intrusion and other adverse environmental impacts, which shall be corrected immediately upon discovery.
- D. Culverts and drainage ditches shall be kept clean and clear of obstruction during construction period.
- E. Sedimentation fence shall be inspected at least daily by the contractor and restored as necessary to its approved, newly installed condition. Accumulations of debris and/or silt shall be removed and properly disposed of as necessary at no additional cost. In no case shall accumulations of more than 6 in. above the original ground line be permitted to remain. If a breach or other failure of the fence occurs, the fence shall be immediately restored. Any delay in maintaining the fence shall be cause to immediately suspend the work as provided for in Subsection 8.09 of the MassDOT Specifications.
- F. Care shall be taken to avoid undermining sedimentation fence during cleanout. If the fabric tears, decomposes, or in any way becomes ineffective, it shall be replaced immediately.
- G. Following the completion of the work and stabilization of adjacent soil, the fence shall be completely removed from the site and the area restored to its original condition.
- H. Catch basin filters shall be inspected by Contractor after each rainstorm and during rain events with 0.39 in. or more of rain in an hour.
- I. Catch basin filters shall be emptied, cleaned, and placed back into the basin once restraint cord is covered with sediment. Filters which become damaged during construction operations shall be repaired or replaced immediately at no additional cost.
- J. Sediment deposits shall be disposed of off-site, in a location and manner which will not cause sediment nuisance elsewhere.

END OF SECTION – 31 25 00

SECTION 32 12 16  
ASPHALT PAVING

**PART 1 - GENERAL**

1.01 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 – GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.
- B. Examine all other Sections of the Specifications and drawings for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section or implied on the drawings.
- C. Coordinate work with trades affecting, or affected by, work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.
- D. All work shall conform to the Town of Northbridge Department of Public Works (DPW) Standards and Specifications.

1.02 SUMMARY

- A. Provide all labor, materials, equipment, services, and transportation required to complete all bituminous concrete paving work as shown on the Drawings, as specified herein, or both.
- B. Perform all work required to complete the work of this Section, as indicated.

1.03 ADA AND MAAB COMPLIANCE

- A. Special attention is to be given to compliance with the Americans with Disabilities Act (ADA) and the requirements of the Massachusetts Architectural Access Board (MAAB).
  - 1. All walkways (as defined by Section 22.1 of 521 CMR) shall be graded to a maximum 4.5 percent. The cross pitch (perpendicular to travel) for all walkways and paths shall be constructed at 1.5 percent.
  - 2. The slope of all ramps and side slopes of handicap curb cuts (as defined by Section 21.1 of 521 CMR) shall be constructed at 7.5 percent maximum. Ramps (as defined by Section 24.1 of 521 CMR) shall be constructed to a maximum slope of 7.5 percent.
  - 3. Accessible parking spaces and loading zones (as defined by Section 23.0 of 521 CMR) shall be level with a surface slope not exceeding 1.9 percent in all directions.
  - 4. The Contractor is to assume that all grades in pedestrian paths of travel shall be verified/checked with a 2 ft. electronic "Smart Level".
- B. The above requirements shall supersede the grades shown on the plans. If these requirements cannot be met with the grades shown on the plans, the Designer shall be notified immediately for direction.
- C. Areas installed which do not meet the above requirements shall be removed and replaced at the Contractor's expense.



1.04 PROJECT CONDITIONS

- A. The Contractor shall use all means necessary to protect the materials of this Section before, during, and after installation. In the event of damage, the Contractor shall make all repairs and replacements necessary to obtain Owner's approval at no additional cost to Owner.
- B. All work shall be executed in such manner as to prevent any damage to existing streets, curbs, paving to remain, existing plant materials, and adjoining properties.
- C. The Contractor shall remove all debris, construction equipment, and waste material from areas within the limit of work prior to inspection for acceptance.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. All products and supplies shall be delivered to the job adequately protected from damage during transit.
- B. All products and supplies shall be stored off the ground and shall be protected against damage. Damaged products and/or supplies will be rejected and shall not be employed in the work.

1.06 QUALITY ASSURANCE

- A. Unless otherwise specified, work and materials for construction of the bituminous concrete paving shall conform to the applicable portions of the following:
  - 1. MassDOT Specification Section 460 for bituminous pavement for roadways and parking areas, Section 701 for bituminous sidewalks, and Section 405 for aggregate base course.
  - 2. MassDOT Specifications Section 472 for repairs to existing pavements after installation of new curb.
- B. Paving work, base courses, wearing courses, and related work shall be done only after excavation and construction work which might injure them has been completed. Damage caused during construction shall be repaired before acceptance.
- C. Repair and replace existing paving areas damaged and removed during this project. Workmanship and materials for such repair and replacement shall match those employed in existing work, except as otherwise noted.
- D. Pavement subbase shall not be placed on muddy or frozen subgrade.
- E. Existing pavement under state or local jurisdiction shall, if damaged or removed during the course of this project, be repaired or replaced under this section of the specification in conformance with applicable codes, standards, and practices.
- F. The Owner reserves the right to retain an independent testing laboratory to perform inspection and testing of paving and associated work.

1.07 RELATED WORK

- A. Section 31 25 00 EROSION AND SEDIMENTATION CONTROLS
- B. Section 33 10 00 WATER UTILITIES
- C. Section 33 30 00 SANITARY SEWAGE  
ASPHALT PAVING

1.08 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO):
  - M81 Cutback Asphalt (Rapid-Curing Type)
  - M140 Emulsified Asphalt
  - T99 Moisture–Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305 mm (12 in.) Drop
- B. American Society for Testing and Materials (ASTM):
  - D1557 Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft.)
- C. Massachusetts Department of Transportation (MassDOT): Highway Division Standard Specifications for Highways and Bridges (MassDOT Specifications)

1.09 SUBMITTALS

- A. Submit manufacturer's product data for the following:
  - 1. Bituminous Pavement Mixes
  - 2. Complete bituminous concrete job mix formula, listing quantities and pertinent ingredient properties, shall be submitted to and approved by the Designer at least two weeks before work is scheduled to begin.

**PART 2 - PRODUCTS**

2.01 GRAVEL SUBBASE

- A. Material for aggregate base course shall be a graded, granular, non-frost susceptible, free-draining material, consisting of either durable stone and coarse sand or of blast furnace slag, practically free from loam and clay, and which can be readily compacted to form a stable foundation.
- B. Material for aggregate base shall conform to MassDOT Specifications Section M1.03.1 Processed Gravel.

2.02 DENSE-GRADED CRUSHED STONE FOR SUBBASE

- A. Material for aggregate base shall conform to MassDOT Specifications Section M2.01.7 Dense-Graded Crushed Stone.

2.03 RECLAIMED BASE COURSE

- A. The work shall consist of scarifying and pulverizing the in-place pavement and underlying material, mixing and/or blending the materials, and spreading and compacting the resultant mixture to the lines and grades shown on the plans or established by the Designer.
- B. All scarified and pulverized material shall pass the 3 in. sieve. Material for blending shall conform to MassDOT Specifications Section M1.03.0 Gravel Borrow, Type B.

2.04 GRAVEL BASE COURSE

- A. Material for aggregate base course shall be a graded, granular, non-frost susceptible, free-draining materials consisting of either durable stone and coarse sand or of blast furnace slag, practically free from loam and clay, which can be readily compacted to form a stable foundation. Material for aggregate base shall conform to MassDOT Specifications Section M1.03.0 Gravel Borrow, Type B.

2.05 BITUMINOUS CONCRETE

- A. Bituminous concrete shall be a standard plant-mixed, hot-laid paving material for road work, consisting of clean, mineral aggregate, mineral filler, and bituminous material conforming to MassDOT Specifications Section M3.11.00 Class I Bituminous Concrete.
- B. Job-mix formula shall comply with Table A Mixes, as specified in MassDOT Specifications Section M3.11.03 Job-Mix Formula.
- C. Base, or bottom course, paving for roadways and parking lots shall have maximum aggregate size passing 2 in. sieve and bitumen content of 4.5 percent (plus or minus 1/2 percent by weight).
- D. Binder course paving for roadways and parking lots shall have maximum aggregate size passing 1 in. sieve and bitumen content of five percent (plus or minus 1/2 percent by weight).
- E. Top, or wearing course, paving for roadways and parking lots shall have maximum aggregate size passing 5/8 in. sieve and bitumen content of 6.5 percent (plus or minus 1/2 percent by weight).
- F. Surface, or wearing course, paving for sidewalks shall conform to composition for “Dense Mix.”

2.06 BITUMINOUS MATERIALS

- A. Bituminous material for tack coat shall be one of the following:
  - 1. Cut-back asphalt (rapid-curing type) conforming to AASHTO M81, Grade RC-70 conforming to MassDOT Specifications Section M3.02.0 Cutback Asphalts.
  - 2. Emulsified asphalt (rapid-setting type) conforming to AASHTO M140, Grade RS-1 conforming to MassDOT Specifications Section M3.03.0 Asphalt Emulsions.
- B. Bitumen shall be a rapid-setting type emulsified asphalt conforming to AASHTO M140, Grade RS-1.
- C. Bituminous crack sealer shall be a hot-applied bituminous sealer conforming to Fed. Spec. SS-S-1401C and MassDOT Specifications Section M3.05.4 Hot Applied Bituminous Concrete Crack Sealer.

**PART 3 - EXECUTION**

3.01 GRADING

- A. Areas to be paved shall be compacted and brought approximately to subgrade elevation before work of this section is performed. Final fine grading, filling, and compaction of subgrade to receive paving, as required to form a firm, uniform, accurate, and unyielding subgrade at required elevations and to required line, shall be done under this Section.

- B. Existing subgrade material which does not readily compact as required shall be removed and replaced with satisfactory materials. Additional materials needed to bring subgrade to required lined and grade to replace unsuitable material removed shall be material conforming to this Section.
- C. Subgrade of areas to be paved shall be recompacted as required to bring top 9 in. of material immediately below gravel base course to compaction of at least 90 percent of maximum dry density, as determined by ASTM D1557, Method D. Subgrade compaction shall extend for a distance of at least 1 ft. beyond pavement edge.
- D. Excavation required in pavement subgrade shall be completed before fine grading and final compaction of subgrade are performed. Where excavation must be performed in completed subgrade or subbase, subsequent backfill and compaction shall be performed as directed by the Designer. Completed subgrade after filling such areas shall be uniformly and properly graded.
- E. Areas being graded or compacted shall be kept shaped and drained during construction. Ruts greater than or equal to 2 in. deep in subgrade shall be graded out, reshaped as required, and recompacted before placing pavement.
- F. Materials shall not be stored or stockpiled on subgrade.
- G. Disposal of debris and other material excavated and/or stripped under this Section, and unsuitable or excess material maintained for completing work of this Section, shall be legally disposed of off-site.
- H. Prepared subgrade will be inspected by Designer. Disturbance to subgrade caused by inspection procedures shall be repaired under this Section.
- I. Compaction of subgrade shall continue until the surface is true and even to the proposed lines and grades, within a tolerance of 1 in. above or below the required cross-sectional elevations and the maximum irregularity not exceeding 1 in. under a 10 ft. line longitudinally.

### 3.02 GRAVEL SUBBASE

- A. Gravel shall be spread and compacted in layers not exceeding 8 in. in depth, except the last layer of gravel subbase (conforming to MassDOT Specifications Section M1.03.0 Gravel Borrow, Type b) shall be 4 in. in depth. Layers shall be compacted to 95 percent of the maximum dry density of the material as determined by AASHTO T99 compaction test, Method C, at optimum moisture content as determined by the Designer.
- B. Any stone with a dimension greater than that permitted for the type of gravel specified shall be removed from the subbase before the gravel is compacted. Compaction shall continue until the surface is true and even to the proposed lines and grades within a tolerance of 3/8 in. above or below the required cross-sectional elevations and the maximum irregularity not exceeding 3/8 in. under a 10 ft. line longitudinally. In locations when 8 in. of gravel is used for gravel base course this tolerance shall be 3/4 in. under a 10 ft. line.
- C. Any area of gravel subbase which, after being rolled, does not form a satisfactory, solid, stable foundation shall be removed, replaced, and recompacted by the Contractor without additional compensation.

### 3.03 DENSE-GRADED CRUSHED STONE SUBBASE

- A. Dense-graded crushed stone shall be spread and compacted in layers not exceeding 8 in. in depth, except the last layer of gravel subbase (conforming to MassDOT Specifications

Section M2.01.7 Gravel Borrow, Type b) shall be 4 in. in depth. Layers shall be compacted to 95 percent of the maximum dry density of the material as determined by AASHTO T99, compaction test Method C, at optimum moisture content as determined by the Designer.

- B. Any stone with a dimension greater than that permitted for the type of gravel specified shall be removed from the subbase before the gravel is compacted. Compaction shall continue until the surface is true and even to the proposed lines and grades within a tolerance of 3/8 in. above or below the required cross-sectional elevations and the maximum irregularity not exceeding 3/8 in. under a 10 ft. line longitudinally. In locations where 8 in. of gravel is used for gravel base course, this tolerance shall be 3/4 in. under a 10 ft. line.
- C. Any area of dense-graded crushed stone subbase which, after being rolled, does not form a satisfactory, solid, stable foundation shall be removed, replaced, and recompact by the Contractor without additional compensation.

#### 3.04 RECLAIMED BASE COURSE

- A. Prior to scarifying and pulverizing the existing pavement, the Contractor shall locate and protect existing drainage and utility structures and underground pipes, culverts, conduits, and other appurtenances. If the upper sections of the utility structures are removed to facilitate scarifying and pulverizing the existing pavement, the remaining part of the structure shall immediately be covered with a steel plate capable of withstanding a 36.5- ton truck load with impact.
- B. The Contractor shall submit to the Designer for approval a description of the equipment and the process to be used for scarifying and pulverizing the existing pavement. The pulverizing operation shall be controlled in such a manner that the resultant material shall be free from excessive fine material (materials passing the No. 200 sieve). The Designer will determine the acceptable level of fine material.
- C. The bituminous pavement and underlying material shall be scarified to the depths shown on the plans or established by the Designer and pulverized and mixed to produce a consistent homogenous material, 100 percent passing the 3 in. sieve and without an excess of material passing the No. 200 sieve. If the Designer directs, gravel borrow (Type b) shall be blended with the pulverized material, in quantities to be established by the Designer, to produce a blend suitable for use as a base course.
- D. Unsuitable materials in the subgrade shall be removed to the lines and depths established by the Designer and replaced with gravel borrow.
- E. The mixed and/or blended base course materials shall be spread and compacted in accordance to the requirements of gravel subbase.

#### 3.05 GRAVEL BASE COURSE

- A. Aggregate base course for paving and the spreading, grading, and compaction methods employed shall conform to standard requirements for usual base course of this type for first class road work and MassDOT Specifications Section 405 Gravel Base Course.
- B. Compaction of aggregate base course shall be to 95 percent of maximum density as determined by ASTM D1557, Method D. Stone greater than 2-1/2 in. shall be excluded from course.
- C. Width of base course shall be greater than the width of pavement surface and shall extend at least twice the base thickness beyond the edge of the course above.

- D. Aggregate material shall be applied in lifts less than or equal to 4 in. thick, compacted measure. Each lift shall be separately compacted to specified density.
- E. Material shall be placed adjacent to wall, manhole, catch basin, and other structures only after they have been set to required grade and level.
- F. Rolling shall begin at sides and progress to center of crowned area and shall begin on low side and progress towards high side of sloped areas. Rolling shall continue until material does not creep or wave ahead of roller wheels.
- G. Surface irregularities which exceed 1/2 in. using a 10 ft. long straightedge shall be replaced and properly compacted.
- H. Subgrade and base course shall be kept clean and uncontaminated. Less select materials shall not be permitted to become mixed with gravel. Materials spilled outside pavement lines shall be removed and area repaired.
- I. Portions of subgrade, or of construction above, which become contaminated, softened, or dislodged by passing of traffic or otherwise damaged shall be cleaned, replaced, and otherwise repaired to conform to the requirements of this specification before proceeding with the next operation.

### 3.06 BITUMINOUS PAVING

- A. Bituminous paving mixture, equipment, methods of mixing and placing, and precautions to be observed as to weather and condition of materials shall conform to MassDOT Specifications Section 460 Class I Bituminous Concrete Pavement for roadway and parking areas and Section 701 Sidewalks, Wheelchair Ramps, and Driveways for sidewalks.
- B. Complete job mix formula, listing quantities and pertinent ingredient properties, shall be submitted to Designer for approval at least two weeks before work is scheduled to begin.
- C. Bituminous base, binder, and wearing courses shall each be applied individually, in single lifts of full thickness indicated on the Drawings.
- D. Work shall not be performed during rainy weather or when temperature is less than 40 degrees Fahrenheit.
- E. Adjacent concrete work, structures, and appurtenances shall be protected from stain and damage during entire operation. Damaged and stained areas shall be replaced or repaired to equal their original condition.
- F. The surface of the pavement to be resurfaced shall receive a bituminous prime coat before laying bituminous binder course. Prime coat shall be applied at rate which shall leave bituminous residue of 5 to 7 gal./100 sq. yd. after evaporation of street. Base surface shall be dry and clean when prime coat is applied. Bituminous paving material shall not be placed until vehicle has completely evaporated from prime coat. Adjoining new paving shall be placed before prime coat has dried or dusted over.
- G. Deliveries shall be timed to permit spreading and rolling all material during daylight hours, unless artificial light, satisfactory to the Designer, is provided. Loads which have been wet by rain or otherwise shall not be accepted. Hauling over freshly laid or rolled material shall not be permitted.

- H. Placing and rolling of mixture shall be as nearly continuous as possible. Rolling shall begin as soon after placing as mixture will bear the operation without undue displacement. Delays in rolling freshly spread mixture shall not be permitted. Rolling shall proceed longitudinally, starting at edge of newly placed material and proceeding toward previously rolled areas. Rolling overlap on successive strips shall be greater than or equal to 1/2 width of roller rear wheel. Alternate trips of roller shall be of slightly different lengths.

Correction required in surface shall be made by removing or adding materials before rolling is completed. Skin patching of areas where rolling has been completed shall not be permitted. Course shall be subjected to diagonal rolling, crossing lines of the first rolling while mixture is hot and in compactable condition. Displacement of mixture or other fault shall be corrected at once by use of rakes and application of fresh mixture or removal of mixture, as required. Rolling of each base course shall be continued until roller marks are eliminated. Roller shall pass over unprotected edge of course only when paving is to be discontinued for sufficient time to permit mixture to become cold.

- I. In places not accessible to roller, mixture shall be compacted with hand tampers. Hand tampers shall weigh at least 50 lbs. and shall have a tamping face less than or equal to 100 sq. in. Mechanical tampers capable of equal compaction will be acceptable in areas in which they can be employed effectively.
- J. Portions of pavement courses which become mixed with foreign material or are in any way defective shall be removed, replaced with fresh mixture, and compacted to density of surrounding areas. Bituminous material spilled outside lines of finished pavement shall be immediately and completely removed. Such material shall not be employed in the work.
- K. Joints shall present same texture, density, and smoothness as other sections of the course. Continuous bond shall be obtained between portions of existing and new pavements and between successive placements of new pavement. New material at joints shall be thick enough to allow for compaction when rolling. Compaction of pavement, base, and subgrade at joints shall be such that there is no yielding of new pavement relative to existing pavement when subjected to traffic.
- L. Contact surfaces of previously constructed pavement (if greater than or equal to seven days since binder placement), manholes, and similar structures shall be thoroughly cleaned and painted with a thick uniform coating of bitumen immediately before fresh mixture is placed. Tack coat shall be applied at rate which will leave asphaltic residue of 5 to 7 gal./100 sq. yd. after evaporation of vehicle. Base surface shall be dry and clean when tack coat is applied. Bituminous paving material shall not be placed until vehicle has completely evaporated from tack coat. Adjoining new paving shall be placed before tack coat has dried or dusted over.
- M. Earth or other approved material shall be placed along pavement edges in such quantity as will compact to thickness of course being constructed, allowing at least 1 ft. of shoulder width to be rolled and compacted simultaneously with rolling and compacting surface. Pavement edge shall be trimmed neatly to line before placing earth or other approved material along edge.
- N. After final rolling, vehicular traffic shall not be permitted on pavement until it has cooled and hardened, and in no case less than six hours.
- O. Variations in smoothness of finished surface shall be less than or equal to the following tolerance when tested with a 10 ft. rolling straightedge, applied both parallel to and at right angles to the centerline of paved areas:

1. For roadway and parking pavement surface course – 1/4 inch in 10 ft.
  2. At joint with existing pavement and at other locations where an essentially flush transition is required, pavement elevation tolerance shall not exceed 0.01 ft.
  3. At other areas pavement elevation tolerance shall not exceed plus or minus 0.05 ft.
- P. Irregularities exceeding these amounts, or which retain water on surface shall be corrected by removing defective work and replacing with new material conforming to this Section for a distance of 30 ft. in all directions of the irregularity.

### 3.07 REPAIRS TO EXISTING PAVEMENT

- A. Subgrade shall be done in strict accordance with Section 31 00 00 EARTH MOVING.
- B. Aggregate base course shall be replaced in strict conformance with this Section.
- C. Bituminous concrete paving mixture, equipment, and methods of mixing and placing shall conform to this Section and MassDOT Specifications Section 472 Bituminous Concrete for Patching.

END OF SECTION - 32 12 16



SECTION 33 10 00  
WATER UTILITIES

**PART 1 - GENERAL**

1.01 GENERAL REQUIREMENTS

- A. Work of this Section requires Trade Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149A Section 8, Chapter 149 Section 44F, and applicable Section of the MGL, Public Contract Law Chapter 30 as amended
- B. The BIDDING REQUIREMENTS, CONTRACT FORMS, and Contract Conditions as listed in the Table of Contents, and applicable parts of Division 1 - GENERAL REQUIREMENTS, shall be included in and made a part of this Section.
- C. Examine all other Sections of the Specifications and drawings for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section or implied on the drawings.
- D. Coordinate work with that of all other trades affecting, or affected by, work of this Section. Cooperate with such trades to ensure the steady progress of all work under the Contract.
- E. All work shall conform to the Town of Northbridge Water Department Standards for Materials and Construction.
- F. All work shall conform to Whitinsville Water Company for Materials and Construction.
- G. Contractor shall register with "Dig Safe" 72 hours prior to construction. It is the Contractor's responsibility to maintain "Dig Safe" registrations and "Dig Safe" markings. Contractor shall comply fully with utility company requirements.

1.02 NORTHBRIDGE WATER DEPARTMENT (NWD) AND WHITINSVILLE WATER COMPANY (WWC)

- A. The Contractor shall notify NWD/WWC sufficiently in advance of connecting new fire protection lines and domestic water service to existing main. All work and materials shall be subject to approval by the NWD/WWC and shall conform to the applicable Town Specifications.
- B. The Contractor shall be responsible for making all arrangements with the Town and paying all fees associated with the water system installation.

1.03 DESCRIPTION OF WORK

- A. Provide all equipment and materials and do all work necessary to construct the water utilities system, including connections to existing structure and testing, as indicated on the Drawings and as specified.
- B. Furnish and install all utility lines, reducers, and appurtenances to a point 10 ft. from the outer face of a foundation wall, unless otherwise indicated on the Drawings.
- C. The Contractor shall pay for all costs and fees related to connecting the water utilities system to existing services and shall file all applications, details, and drawings required by the local authority having jurisdiction.

- D. This Section also includes the following by the Fire Protection Filed Sub-bidder:
1. All fire protection lines and structures (valves, hydrants, and other appurtenances, including thrust blocks) shall be furnished and installed by the Fire Protection filed subcontractor or approved site subcontractor. All excavation and backfilling, including thrust blocks, shall be provided by the site subcontractor

#### 1.04 RELATED WORK

- |    |                  |                                    |
|----|------------------|------------------------------------|
| A. | Section 31 00 00 | EARTHWORK                          |
| B. | Section 31 10 00 | SITE PREPARATION                   |
| C. | Section 31 25 00 | EROSION AND SEDIMENTATION CONTROLS |
| D. | Section 32 12 16 | ASPHALT PAVING                     |
| E. | Section 33 30 00 | SANITARY SEWERAGE                  |

#### 1.05 REFERENCE STANDARDS

- A. American National Standards Institute/American Water Works Association (ANSI/AWWA):

- |             |   |
|-------------|---|
| C104/A21.4  | Cement-Mortar Lining for Ductile-Iron Pipe and Fittings             |
| C105/A21.5  | Polyethylene Encasement for Ductile Pipe Systems                    |
| C110/A21.10 | Ductile Iron and Gray-Iron Fittings                                 |
| C111/A21.11 | Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings    |
| C150/A21.50 | Thickness Design of Ductile-Iron Pipe                               |
| C151/A21.51 | Ductile-Iron Pipe, Centrifugally Cast                               |
| C500        | Metal-Seated Gate Valves for Water Supply Service                   |
| C509        | Resilient-Seated Gate Valves for Water Supply Service               |
| C515        | Reduced-Wall, Resilient Seated Gate Valves for Water Supply Service |
| C550        | Protective Interior Coatings for Valves and Hydrants                |
| C600        | Installation of Ductile-Iron Mains and Their Appurtenances          |
| C651        | Disinfecting Water Mains  |
| C800        | Underground Service Line Valves and Fittings                        |

- B. American Society for Testing and Materials (ASTM):

- |      |   |
|------|---|
| A126 | Gray Iron Castings for Valves, Flanges, and Pipe Fittings |
|------|---|

A536	Ductile Iron Castings
B88	Seamless Copper Water Tube
B584	Copper Alloy Sand Castings for General Applications

C. Town of Northbridge Department of Public Works – Standards & Specifications

1.06 SUBMITTALS

- A. Manufacturer's product data shall be submitted for the following:
  - 1. Pipe and fittings
  - 2. Couplings
  - 3. Tapping sleeve and valve
  - 4. Valve box
  - 5. Valves, each type
  - 6. Hydrants
  - 7. Detectable warning tape
- B. Copy of disinfection results.

1.07 INSPECTION AND TESTING

- A. Pipe and fittings shall be inspected and tested at the foundry as required by the standard specifications to which the material is manufactured. The Contractor shall furnish to the Designer, in duplicate, sworn certificates of such tests.
- B. The Owner reserves the right to have any or all pipe, fittings, and special castings inspected and/or tested by an independent testing agency at either the manufacturer's plant or elsewhere. Such inspections and/or tests shall be at the Owner's expense.
- C. Ductile iron pipe and fittings shall be subject to a careful inspection and a hammer test just before being installed.

**PART 2 - PRODUCTS**

2.01 DUCTILE IRON PIPE AND PIPE FITTINGS

- A. Ductile iron (DI) pipe for water mains shall be designed in accordance with ANSI/AWWA C150/A21.50 and shall be manufactured in accordance with ANSI/AWWA C151/A21.51. Unless otherwise indicated or specified, ductile iron pipe shall be at least thickness Class 52.
- B. If corrosive soils are found where pipe is installed, pipe shall be encased in polyethylene per ANSI/AWWA C105/A21.5
- C. DI pipe and fittings shall be push-on joint type with bell and plain spigot end, unless grooved or flanged ends are indicated.
- D. DI pipe and fittings shall conform to ANSI/AWWA C153. Joints shall have the same pressure rating as the pipe or fitting of which they are a part.
- E. Gaskets shall conform to ANSI/AWWA C111/A21.11.

- F. Inside of pipe and fittings shall be given a cement lining and bituminous seal coat in accordance with ANSI/AWWA C104/A21.4. Interior coating shall be a product acceptable to the National Sanitation Foundation (NSF) for use in potable water and shall be listed in the most current NSF summary of approved products.
- G. Pipe for use with sleeve-type couplings shall be as specified above except that the ends shall be plain (without bells or beads). The ends shall be cast or machined at right angles to the axis.
- H. Pipe shall be manufactured in the United States.

## 2.02 COPPER PIPE

- A. Copper water service pipe shall be soft, annealed, seamless copper tubing conforming to the NSF/ANSI 61 Annex G requirements and shall be manufactured to meet ASTM B88, Type K.
- B. Tube shall be clean, smooth, round, straight (when applicable), of proper dimensions, and free of grooving, indentations, cracks, flaws, and other defects that would interfere with normal applications. Normal incised marking is acceptable.
- C. Joints in the copper service tubing shall be kept to a minimum by use of coiled copper.
- D. Where necessary, joints shall be made with three part compression couplings, flared tube fittings (ASA Spec B-16), or an approved equal. All fittings shall be electrically conductive.
- E. Bends in copper service pipe, particularly gooseneck bends, shall be made with a bending tool especially designed for that purpose.
- F. Service fittings shall include a corporation stop with a curb stop service box, with frame and cover extending to the surface.
- G. The Contractor shall furnish to the [Engineer] satisfactory evidence that the copper tubing and fittings meet the requirements of these Specifications.

## 2.03 TAPPING SLEEVES AND VALVES

- A. When connections to existing water mains are required, a tapping sleeve and valve shall be used, of adequate size and pressure to ensure the continued flow of water through the existing main throughout construction.
- B. Tapping sleeve and valve shall consist of a split cast iron sleeve tee with mechanical joint ends on the main and a flange on the branch, and a tapping type gate valve with one flange and one mechanical joint end.
- C. A gate valve and box shall be installed with the tapping sleeve.
- D. Valve shall conform to the requirements specified below for gate valve.
- E. The Contractor shall be responsible for verifying the outside diameter of the pipe to be tapped. Valve shall have oversized seat to permit the use of full-size cutters.

2.04 VALVES AND VALVE BOXES

- A. The resilient wedge gate valves shall fully comply with the latest revision of AWWA C509 or AWWA C515 and shall also be UL listed and FM approved. The valves shall be tested and certified to ANSI/NSF 61.
- B. The valve shall be rated for a minimum of 300 psi and tested to 400 psi.
- C. Valves shall be Type A2361 as manufactured by Mueller Company, American Flow Control (AFC) Series 3500, or an approved equal.
- D. The valve shall have an arrow cast on the operation nut showing opening direction. Valves shall open [LEFT/RIGHT].
- E. All operating nuts shall be 2 in. square at the base, tapering to 1-15/16 in. square at the top.
- F. All valves shall have mechanical joint ends, complete with all accessories. Bolts shall be CorTen or approved equal.
- G. The valve body, bonnet, stuffing box, and disc shall be composed of ASTM A126, Class B cast iron, or ASTM A536 ductile iron. The body and bonnet shall also adhere to the minimum wall thickness as set forth in Table 2 of AWWA C509 or C515. Wall thicknesses less than those in Table 2 are not acceptable.
- H. All bonnet bolts, seal plate bolts, stuffing box bolts, and other bolts in contact with soil (except for MJ bolts) shall be 18-8 Type 304 stainless steel or Everdur bronze.
- I. The valve disc and guide lugs must be fully encapsulated in SBR ASTM D2000 rubber material. Guide caps of an acetyl bearing material shall be placed over solid guide lugs to prevent abrasion and to reduce the operating torque. Rubber for valve seats shall be new, natural, or synthetic, of a compound designated for water service applications. Reclaimed rubber is unacceptable.
- J. Rubber seats shall be either bonded to or mechanically attached to the gate. When mechanically attached, all exposed hardware shall be 18 - 8 Type 304 stainless steel.
- K. The valves shall have all internal and external ferrous surfaces coated with a fusion- bonded epoxy coating with 10 mils nominal thickness and conforming to AWWA C550.
- L. Stem shall be of the non-rising type.
- M. Stem seals shall consist of two "O" rings, one as a dirt seal and one as a pressure seal.
- N. The upper "O" ring stem seal shall be replaceable with the valve under pressure in the fully open position.
- O. A thrust washer of Teflon or approved equal shall be used directly above the stem collar.
- P. The valve shall be able to withstand an input torque of 300-foot pounds with no distortion of the stem or other damage to the valve.
- Q. The flow way shall be fully unobstructed with no pockets in bottom of flow-way to trap sediment or debris.
- R. All 4 in. and 6 in. gate valves shall be provided with a valve box and cover. Box shall be cast iron and shall be an adjustable, telescoping, heavy-pattern type.

1. Box shall be designed and constructed to prevent the direct transmission of traffic loads to the pipe or valve.
  2. Upper section of box shall have a flange with sufficient bearing area to prevent undue settlement. Lower section of box shall be designed to enclose the valve operating nut and stuffing box, and rest on the bonnet or backfill.
  3. Boxes shall be capable of vertical adjustment of a minimum of 6 in. without reduction of overlap between sections to less than 4 in.
  4. Inside diameter of box shall be a minimum of 4-1/2 in. and length of box shall be as needed to suit finish ground elevation.
  5. Box cover shall be close fitting and substantially airtight. Top of cover shall be flush with top of box rim. Cover shall have an arrow indicating the direction of opening and the word "OPEN" cast into top.
- S. All valves 8 in. and larger shall be provided with a roadway frame and cover, unless plans call for chamber.
1. Roadway frames and covers shall be Northbridge standard, 16 in. by 18 in.
  2. Valves requiring a roadway frame and cover shall be fitted with a standpipe having a diameter of at least 12 in.
  3. Standpipes shall be Class 52 ductile iron pipe.
  4. Standpipes shall be cut to a length to enable them to fit inside the roadway frame and cover, so they do not transmit loads to the pipe or valve.
  5. All roadway covers shall be cast with the appropriate markings to signify the type of valve installed.
  6. The valve-operating nut shall be centered in the valve tube and visible upon installation.
- T. All valves shall be manufactured in the United States.

## 2.05 MECHANICAL JOINT RESTRAINTS

- A. Restraint devices for nominal pipe sized 4 in. through 48 in. shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C153.
- B. The device shall have a working pressure rating of 350 psi for 3 in. – 16 in. and 250 psi for 18 in. – 48 in. nominal sizes.
- C. Gland body, wedges, and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536.
- D. All wedge assemblies and related parts shall be processed through a phosphate wash, rinse, and drying operation prior to coating application. The coating shall consist of a minimum of two coats of liquid thermoset epoxy coating with heat cure to follow each coat.
- E. All casting bodies shall be surface pretreated with a phosphate wash, rinse, and sealer before drying. The coating shall be electrostatically applied, and heat cured. The coating shall be a polyester-based powder to provide corrosion, impact, and UV resistance.
- F. The coating system shall be MEGA-BON by EBAA Iron, Inc. or approved equal.

2.06 EMBEDMENT MATERIALS

- A. Ductile iron water pipe shall use materials defined in AWWA C600, Sec. 3.5, Backfilling and shall confirm to MassDOT Specifications M1.01.0.
- B. Backfill material shall be of good quality and free from cinders, frozen material, ashes, refuse, boulders, rocks, or organic material.
- C. Pipe bedding shall be washed and screened sharp gravel, well graded in sizes from 1/4 in. to 1-1/2 in., inclusive. It shall be clean, hard, durable, and free from dust, clay, or organic matter. It shall be well compacted in place.

2.07 DETECTABLE WARNING TAPE

- A. Tape shall consist of a minimum 5 mil overall thickness with no less than a 0.35 mil solid aluminum foil core. Solid foil core shall be encased between a 100 percent virgin polyethylene film and clear protective film which allows a full view of the foil and printed message. All detectable marking tapes shall be permanently printed.
- B. Color shall conform to Town of Northbridge standards.
- C. Tape shall be BLUE with the words "WATER LINE BELOW" printed consistently on it.
- D. Manufactured from durable and resistant elements.

2.08 EMBEDMENT MATERIALS

- A. Gravel borrow shall be a granular material, well graded from fine to coarse, with a maximum size of 3 in., obtained from approved natural deposits and unprocessed except for the removal of unacceptable material and stones larger than the maximum size permitted

2.09 HYDRANT

- A. Hydrant shall conform to AWWA C502 and local governmental authorities having jurisdiction. Hydrant shall be positive automatic drain type to prevent freezing and shall have one 4-1/2 in. pumper and two 2-1/2 in. hose connections. Main valve opening shall be 5-1/4 in. and valve shall open to meet Town of Northbridge standard. Inlet connection shall be 6 in., mechanical joint.
- B. Hydrants shall conform to National Standard Specification sizes in threads and nuts. Caps shall have retainer chains and rubber gaskets.
- C. Hydrants shall conform to the "standard dry barrel hydrants" AWWA C502
- D. Hydrants shall be hydrostatically tested as specified in AWWA C502
- E. Hydrant shall be approved by the Northbridge Water Department and shall be manufactured by one of the following:

Mueller Co., Decatur, IL;  
Kennedy Valve Mfg. Co., Elmira, NY;  
American-Darling Valve, Birmingham, AL;  
Or approved equal.

- F. Color of hydrant shall match Town of Northbridge standard.

#### 2.010 PIPE INSULATION WRAP

- A. All suspended pipes and/or where called out on the plans shall be wrapped with pipe insulation.
- B. Pipe Insulation shall be made from Rubber modified asphalt with cross-laminated polyethylene.
- C. The pipe insulation rap shall be able to be used within the temperature range of -25°F to 160°F (-32°C to 71°C)
- D. The wrap thickness shall be:
  - 1. 50mils (1.33 mm)
  - 2. Tensile Strength >400 psi
  - 3. Elongation >300%
  - 4. Water Vapor Permeance (ASTM F 1249) <0.015 perms. Tested at 100°F and 90% RH
  - 5. Puncture resistance (ASTM E 154) = 50lbf minimum
  - 6. Overlap Adhesion (ASTM D 903) > 7.0 lb/in width
  - 7. Surface Burning characteristics (ASTM E 84)
    - a. Flame spread = 0
  - 8. Resistance to deterioration from contact with soil (ASTM 154) = Pass; No loss of performance
  - 9. Pliability at low temperatures (ASTM D 146) no cracking remains pliable at -25°F

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Inspect all parts of the Project where WATER UTILITIES are to be installed and the conditions under which the work must be performed. Report in writing to the Construction Manager, with copy to the Designer, any conditions which might adversely affect the installation. Do not proceed with the installation until defects have been corrected and conditions are satisfactory.

#### 3.02 FIRE PROTECTION LINES AND STRUCTURES

- A. All fire protection lines and structures (valves, hydrants, and other appurtenances, including thrust blocks) specified in this Section shall be installed by the fire protection subcontractor

#### 3.03 HANDLING AND CUTTING DUCTILE IRON PIPE

- A. The Contractor's attention is directed to the fact that the cement pipe lining is comparatively brittle. Every care shall be taken in handling and laying pipe and fittings to avoid damaging the pipe, fittings, and linings, scratching, or marring machined surfaces, and abrasion of the pipe coating or lining.
- B. Any fitting showing a crack and any fitting or pipe which has received a severe blow that may have caused an incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work.



- C. In any pipe showing a distinct crack and in which it is believed there is no incipient fracture beyond the limits of the visible crack, the cracked portions, if so approved, may be cut off by and at the expense of the Contractor before the pipe is laid so that the pipe used will be perfectly sound. The cut shall be made in the sound barrel at a point at least 12 in. from the visible limits of the crack.
- D. Except as otherwise approved, all cutting shall be done with an approved power operated cutter. Hammer and chisel or hydraulic squeeze cutters are not acceptable for cutting ductile iron pipe. Ductile iron pipe may be cut using an abrasive cut-off saw, rotary wheel cutter, milling wheel saw, or guillotine pipe saw. All cut ends shall be examined for possible cracks caused by cutting. Cut ends shall be beveled with a heavy file or grinder to remove all sharp edges. Beveling with a saw blade is not acceptable.
- E. The Contractor's attention is directed to the fact that damage to the lining of pipes or fittings will render them unfit for use. The Contractor shall use the utmost care in handling and installing lined and coated pipe and fittings to prevent damage. Protective guards shall not be removed until the pipe is to be installed.

#### 3.04 PIPE AND FITTINGS INSTALLATION

- A. Piping shall be installed as indicated on the Drawings. Where exact locating dimensions of piping are not indicated on the Drawings, the Designer's approval shall be obtained for proposed locations before installation.
- B. Each pipe and fitting shall be carefully cleared of all debris, dirt, and other foreign materials, before being laid and shall be maintained free from foreign matter during installation, until accepted in the complete work.
- C. At all times when pipe laying is not actually in progress, the open ends of the pipe shall be closed by temporary watertight plugs or by other approved means. If water is in the trench when work is resumed, the plug shall not be removed until all danger of water entering the pipe is eliminated.
- D. Entire length of pipe shall be thoroughly flushed clean, disinfected, and flushed again following completion of backfill and passing of leakage and pressure testing.
- E. All pipes and fittings shall have no less than 5 ft. and no more than 6 ft. of cover unless otherwise indicated or approved. No pipe shall be laid in the same trench with gas pipes, sewer pipes, or any other facility of a public service company, no within 5 feet of any open excavation or vault, nor within 10 ft. of any septic structure or leaching field.
- F. Ductile iron pipe and fittings shall be installed in accordance with ANSI/AWWA C600, Laying Condition Type Four.
- G. Bottom of trench excavation shall be kept dry and free of water during pipe installation. Adequate measures shall be taken to prevent flotation of pipe in the trench.
- H. Each pipe length shall be installed to form a close joint with the next adjoining length and bring inverts to the required grade.
- I. Each pipe length shall have a firm bearing along its entire length. No pipe or fitting shall be permanently supported on saddles, blocking, or stones.
- J. Water service line shall be installed in accordance with AWWA C800 and as indicated on the Drawings.

- K. Push-on joints shall be made in strict accordance with the manufacturer's instructions. A rubber gasket shall be inserted in the groove of the bell end of the pipe and joint surfaces cleaned and lubricated. The plain end of the pipe to be entered shall than be inserted in alignment with the bell of the pipe to which it is to be jointed and pushed home with a jack or by other approved means. After jointing the pipe, a metal feeler shall be used to make certain that the rubber gasket is located correctly.
- L. Piping shall be properly graded, free from pockets.
- M. Changes in direction, both vertical and horizontal, of water pipelines shall be braced with concrete thrust blocks and/or restraint joints (Megalugs, Star, or approved equal). Concrete thrust blocks shall be used only where they will bear on undisturbed earth.
- N. Warning tape shall be installed along the whole length of the installed pipe and shall be placed on the top of the embedment material as indicated on the Drawings.

### 3.05 MECHANICAL JOINT RESTRAINTS

- A. Mechanical joint restraint shall require conventional tools and installation procedures per AWWA C600 while retaining full mechanical joint deflection after assembly.
- B. Proper actuation of the gripping wedges shall be ensured with torque limiting twist off nuts.

### 3.06 TAPPING SLEEVE AND VALVE

- A. Tapping sleeve and valve shall be installed in accordance with the valve manufacturer's recommendations. The tapping sleeve shall be bolted around the existing water main, and bolts tightened. Valve shall be bolted to the flanged outlet of the sleeve with the valve open, the tapping machine bolted on, and the tap made. The cutter shall then be withdrawn, the valve closed, and the tapping machine removed.

### 3.07 PIPE INSULATION WRAP

- A. Contractor to follow manufacturers installation directions.
- B. Insulation must be properly secured in place per insulation manufactures instructions. Remove any loose insulation, dust, or other contaminants.
- C. Apply below 125°F (52°C). Sheet should be stored at 70o F for at least 24 hours before applying in temperatures below 60oF. Keep rolls warm until used. See application guide for applying in temperatures below 50°F (10°C).
- D. Do not apply to damp, frosty, or contaminated surfaces. Membrane should not be left exposed to UV for more than 14 days. Cover with jacketing as specified. If jacketing is not to be applied for longer than 14 days, cover temporarily with black plastic sheeting
- E. Membrane is not to be used for banding or mechanical fastening. Standard fastening of insulation is required.
- F. The Wrap is best applied by cigarette wrapping. Cut membrane to desired length. Ensure length includes a minimum 2" (50 mm) overlap. Start by positioning the membrane such that the finished overlap will allow for water to drain over and not into the lap. Peel back six to twelve inches of the release liner taking care not to allow any exposed adhesive to touch itself. Firmly press exposed edge of sheet in place and continue removing release liner and smoothing sheet to substrate. Avoid wrinkling

- G. All longitudinal and circumferential seams must be overlapped a minimum of 2" (50 mm). Ensure complete contact at the laps and to the substrate using a roller or firm pressure throughout. Stagger laps of subsequent pieces. When C.I. Wrap is applied to the insulation in the shop, finish butted up seams in the field using 4" (100 mm) wide C.I. Wrap evenly spaced over the joint and wrapping all the way around the pipe overlapping a minimum of 2". Any fish mouths or wrinkles in the sheet shall be slit to allow for smoothing and wrapped with a 4" strip that covers the entire seam with a minimum 2" overlap.

### 3.08 TESTING

- A. All portions of the water system shall be tested for leakage. System may be tested by the use of either water or low-pressure air.
- B. Notice of tests shall be made in writing to the Designer, the WWC, and the Plumbing Inspector, and received by them not less than five days before the date of test.
- C. The Contractor shall notify the WWC sufficiently in advance of connecting new main to existing main. All work and materials shall be subject to approval by the WWC and shall conform to the applicable Town Specifications.
- D. The Contractor shall be responsible for making all arrangements with the utility company and paying all fees (if required) associated with the water system installation.
- E. General test requirements.
  - 1. Piping shall be adequately restrained against movement before testing. Pressure line shall have thrust blocks installed and the concrete shall have attained full design strength before test pressure is applied to the line.
  - 2. Piping system shall be flushed clean, and sediment, scale, dirt, and debris removed before piping is tested.
  - 3. Adequate provision shall be made for carrying off flushing water without causing erosion or other damage.
  - 4. Piping shall be tested before joints are concealed or made inaccessible.
  - 5. The Contractor shall furnish all labor, pumps, taps, chemicals, and other necessary equipment to conduct hydrostatic pressure tests, measured leakage tests, and laboratory bacteriological analysis on mains laid and/or lined under this contract in accordance with the applicable requirements of AWWA C600, ASTM C969, and ASTM C1244.
  - 6. In the event that the work fails to meet the required standards as stated herein, the Contractor shall perform such excavation, repair, re-laying of pipe, re-chlorinating, and all other work necessary to correct the work and shall repeat the tests as often as may be necessary and until such time as the required standards are met.
  - 7. Tests shall be made in the presence of an Inspector of the authority having jurisdiction.
- F. Pressure and Leakage Tests.
  - 1. Pressure pipe shall be given combined pressure and leakage tests in sections of acceptable length.
  - 2. The Contractor shall furnish and install suitable temporary testing plugs or caps; all necessary pressure pumps, pipe connections, meters, gages, and other necessary equipment; and all labor required.
  - 3. Unless it has already been done, the section of pipe to be tested shall be filled with water of approved quality, and all air shall be expelled from the pipe. If hydrants or blowoffs are not available at high points for releasing air, the Contractor shall make the necessary excavations and do the

necessary backfilling and shall make the necessary taps at such points and shall plug said holes after completion of the test.

4. The section under test shall be maintained full of water for a period of 24 hours prior to the combined pressure and leakage test being applied.
5. The meter and gage shall be installed by the Contractor and shall be kept in use during the test in such a manner that all water entering the water main under test will be measured
6. The pressure test shall consist of first raising the water pressure (based on the elevation of the lowest point of the section under test and corrected to the gage location) to a pressure of 150 lbs. per sq. in. If the Contractor cannot achieve the specified pressure and maintain it for a period of two hours with no additional pumping, the section shall be considered as having failed to pass the test.
7. Following a successful pressure test, or concurrently therewith, the Contractor shall make a leakage test by metering the flow of water into the pipe while maintaining in the water main a pressure equal to the specified test pressure. If the average leakage during the 4-hour period exceeds a rate of 20 gallons per 24 hours per inch of inside diameter per mile of pipeline, the section shall be considered as having failed the leakage test.
8. No pipeline installation will be accepted if the leakage is greater than that shown in the following table.

<b>Allowable Leakage (gal/hr) per 1,000 ft. of pipeline</b>								
<b>Avg. Test Pressure (psi)</b>	<b>Nominal Pipe Diameter (in.)</b>							
	<b>3</b>	<b>4</b>	<b>6</b>	<b>8</b>	<b>10</b>	<b>12</b>	<b>14</b>	<b>16</b>
350	0.42	0.56	0.84	1.12	1.40	1.69	1.97	2.25
300	0.39	0.52	0.78	1.04	1.30	1.56	1.82	2.08
250	0.36	0.47	0.71	0.95	1.19	1.42	1.66	1.90
200	0.32	0.43	0.64	0.85	1.06	1.28	1.48	1.70
175	0.30	0.40	0.59	0.80	0.99	1.19	1.39	1.59
150	0.28	0.37	0.55	0.74	0.92	1.10	1.29	1.47
125	0.25	0.34	0.50	0.67	0.84	1.01	1.18	1.34
100	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20

9. If the section shall fail to pass the pressure test, the leakage test, or both, the Contractor shall do everything necessary to locate, uncover, and repair or replace defective pipes, fittings, or joints, all at his own expense, and without extension of the time for completion of the work. Additional tests and repairs shall be made until the section passes the specified tests.
  10. All joints within vaults shall have no visible leakage. Joints from which water continues to run or squirt in an active manner will not be accepted.
  11. Upon successful completion of the tests, plugs or caps installed for the testing shall be removed.
  12. If, in the judgment of the Designer, it is impracticable to flow the foregoing procedure exactly for any reason, modifications in the procedure shall be made as required and accepted, but in any event the Contractor shall be responsible for the ultimate tightness of the line within the above leakage and pressure requirements.
- G. Before submitting system for final approval of the authorities having jurisdiction, the Contractor shall submit to the Owner and the Designer a written statement stating that the work has been completed in accordance with the Specifications and Drawings.
- H. Promptly following satisfactory completion of leakage testing, a report fully describing test procedures and listing test results shall be submitted to the Designer. The report shall be signed by the Contractor's Superintendent.

### 3.09 DISINFECTION

- A. After completion of all water main related construction, except water service connection installation, all water mains, valves, hydrants, hydrant connections and other appurtenances installed under this Contract shall, be disinfected in accordance with AWWA Standard C651, Section 4.4.3 (Continuous Feed Method), as modified herein.
1. All existing hydrants and valves shall be operated by Northbridge Water Department or WWC personnel only. The contractor is not permitted to operate Town owned hydrants and valves.
  2. Taps for flushing, chlorination and sampling shall be installed by the Contractor at no additional expense to the Town of Northbridge or WWC.
  3. Flush the new water mains with potable water to remove any contaminants and debris that may have entered the water mains during construction.
  4. The flushing velocity in the new water mains shall not be less than 2.5 feet per second. In the absence of a flow meter, flow rate shall be determined either by placing a pitot gage at the discharge or by measuring the time to fill a container of a known volume
  5. Prepare a chlorine solution that will be continuously fed into the potable water that is used to fill the new water mains.
  6. The chlorine solution shall be applied to the new water mains with a chemical feed pump designed to feed chlorine solutions.
  7. Completely fill the new water mains with the chlorinated, potable water to remove any air pockets. The point of application shall be no more than 10 feet downstream from the beginning of the new water mains.
  8. The chlorine solution shall be of sufficient strength to provide a minimum residual chlorine concentration of 25 milligrams per liter (mg/l) in the filled water mains.
  9. New valves and hydrants shall be operated to insure their proper disinfection.
  10. Isolation valves shall be maintained in a closed position to prevent chlorinated water from entering the existing water distribution system.
  11. Chlorinated water shall remain in the main for a minimum of 48 hours.
  12. The minimum residual chlorine concentration at the end of the 48-hour holding period shall be 10 mg/l.
  13. After the 48-hour retention period, chlorinated water shall be flushed from every hydrant branch on the main until the chlorine concentration leaving the main is no higher than that generally in the system or less than 1.0 mg/l.
  14. Chlorinated water shall be discharged in a manner that will not adversely affect flora and fauna or drainage courses and shall conform to applicable State regulations for waste discharge.
  15. Chlorinated water that is flushed from the mains shall be neutralized by the addition of a dechlorinating agent so that the residual chlorine concentration is zero.
  16. The location of the discharge for the dechlorinated water shall be approved by the Department of Public Works

### 3.010 BACTERIOLOGICAL TESTS

- A. A minimum of 48 hours after flushing and before the new water mains are placed in service, the Contractor shall collect water samples for testing of the bacteriological quality of the water.
1. No hose or fire hydrant shall be used in the collection of samples.
  2. A sampling tap shall consist of a standard corporation stop installed in the main with a PVC gooseneck assembly.
  3. Samples for bacteriological testing shall be collected in sterile bottles treated with sodium thiosulfate and furnished by the state certified laboratory that will perform the tests.

4. A private company specializing in this field shall chlorinate the main, take the samples and have the same tested by an approved laboratory.
  5. Unless otherwise directed by the Water Department, the minimum number of samples for bacteriological analysis shall be as follows:
  6. One sample every 1,000 linear feet of newly installed water mains.
  7. One sample at the end of the newly installed water mains.
  8. One sample at each branch.
- B. All bacteriological tests shall be performed by a state certified laboratory.
1. Two bacteriological tests shall be performed on all samples:
    - a. one coliform bacteria
    - b. One heterotrophic plate count (HPC) bacteria.
  2. Test results on all samples and a copy of the chain of custody shall be mailed directly to the Northbridge Water Department and WWC from the laboratory.
  3. The disinfection procedure shall be considered satisfactory only if the results of all tests confirm the following:
    - a. the absence of coliform bacteria in all samples taken and
    - b. the HPC bacteria are 10 or less colony forming units per milliliter (cfu/ml) in all samples taken (unless the water supplier has established a stricter HPC limit from baseline data for their water distribution system, in which case the results of the HPC bacteria tests shall meet the stricter limit).
  4. The new water mains may be placed in service if the results of the disinfection procedure are satisfactory, and the Water Department has granted permission.
  5. If the initial disinfection procedure fails to produce satisfactory results, the new water mains shall be flushed and resampled as described above. If the test results from the resampling also fail to produce satisfactory results, the entire disinfection procedure shall be repeated.

### 3.011 AS-BUILTS

- A. The Contractor shall provide the Designer with as-builts of all the newly installed Water and Fire protection lines. The as-built shall be based on a field survey and include locations and depths of all pipes and fixtures, and shall be shown on a site plan and in AutoCAD format. The Contractor shall also supply the Designer with the model/serial number of all tapping sleeves, and water meters installed as part of the project.

END OF SECTION – 33 10 00

SECTION 33 30 00  
SANITARY SEWAGE

**PART 1 – GENERAL**

1.01 GENERAL REQUIREMENTS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 – GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.
- B. Examine all other Sections of the Specifications for requirements which affect work of this Section, whether or not such work is specifically mentioned in this Section.
- C. Coordinate work with trades affecting, or affected by, work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.
- D. All work shall conform to Northbridge Department of Public Works (DPW) Standards for Materials and Construction.
- E. Contractor shall register with “Dig Safe” 72 hours prior to construction. It is the Contractor’s responsibility to maintain “Dig Safe” registrations and “Dig Safe” markings. Contractor shall comply fully with utility company requirements.

1.02 NORTHBRIDGE DEPARTMENT OF PUBILC WORKS (DPW)

- A. The Contractor shall notify Northbridge DPW sufficiently in advance of connecting new main to existing main. All work and materials shall be subject to approval by the Northbridge DPW and shall conform to the applicable Northbridge Specifications.
- B. The Contractor shall be responsible for making all arrangements with the Northbridge and paying all fees associated with the sewer system installation.

1.03 WORK INCLUDED

- A. Provide all equipment and materials and do all work necessary to construct the sewer system, including connections to existing structures and testing, as indicated on the Drawing and as specified.
- B. Unless otherwise indicated on the Drawings, sewer lines shall be installed to a point 10 ft. from the outer face of a foundation wall.
- C. The Contractor shall pay for all costs and fees related to connecting sanitary sewerage system to existing services and shall file all applications, details, and drawings required by the local authority having jurisdiction.

1.04 RELATED WORK

- A. Section 31 00 00 EARTHWORK
- B. Section 31 10 00 SITE PREPARATION
- C. Section 31 25 00 EROSION AND SEDIMENTATION CONTROLS

D. Section 33 10 00 WATER UTILITIES

1.05 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO): Standard Specifications for Highways and Bridges
- B. American Society for Testing and Materials (ASTM):
  - A48 Gray Iron Castings
  - A74 Cast Iron Soil Pipe and Fittings
  - A615 Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
  - A888 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
  - C270 Mortar for Unit Masonry
  - C443 Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
  - C478 Circular Precast Reinforced Concrete Manhole Sections
  - C564 Rubber Gaskets for Cast Iron Soil Pipe and Fittings
  - C828 Test Method for Low-Pressure Air Test of Vitrified Clay Pipelines
  - C969 Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe  
Sewer Lines
  - C990 Joints for Concrete Pipe, Manholes, and Precast Box Sections Using  
Preformed  
Flexible Joint Sealants
  - C1227 Precast Concrete Septic Tanks
  - C1244 Test Method for Concrete Sewer Manholes by the Negative Air Pressure  
(Vacuum) Test Prior to Backfill
  - C1277 Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings
  - C1613 Precast Concrete Grease Interceptor Tanks
  - D2729 Poly(Vinyl Chloride) (PVC) Sewer Pipe - Dimensions
  - D3034 Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
  - D3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
  - F477 Elastomeric Seals for Joining Plastic Pipe



F1417 Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air

F2649 Corrugated High Density Polyethylene (HDPE) Grease Interceptor Tanks

C. Federal Specifications (Fed. Spec.)

QQ-A-200/8 Aluminum Alloy 6061 Bar, Rod, Shapes, Tube, and Wire, Extruded

D. Cast Iron Soil Pipe Institute (CISPI):

301 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

310 Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

E. Massachusetts Department of Transportation (MassDOT): Highway Division Standard Specifications for Highways and Bridges (MassDOT Specifications)

1.06 SUBMITTALS

A. Manufacturer's product data:

1. Precast Structures
2. Castings
3. Non-shrink Grout
4. Cement Concrete
5. PVC Pipe and Fittings
6. Cast Iron Soil Pipe and Fittings

**PART 2 – PRODUCTS**

2.01 SANITARY SEWER MANHOLES

- A. Sanitary sewer manholes shall be constructed according to the specifications of Northbridge and as shown on the Drawings.
- B. Manholes and access risers shall be designed to safely withstand an AASHTO HS-20 loading, as specified in the AASHTO Specifications.
- C. Manholes shall be reinforced precast concrete unless specified by the Engineer or approved as a change by the Engineer.
- D. Precast concrete structures shall be Type II cement unless specifically authorized in writing, conform to ASTM C478, and shall be similar to those produced by the manufacturers in the table below.

Manufacturer
Concrete Systems Inc., Hudson, NH

E.F. Shea Concrete Products, Amesbury, MA
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Oldcastle Infrastructure, Rehoboth, MA
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- E. Sections shall have tongue and groove joints.
- F. Joints between sections shall be made with preformed rubber gaskets conforming to ASTM C443 as shown on the Drawings.
- G. Joints between sections shall be sealed with a preformed flexible joint sealant conforming to the requirements of ASTM C990. The manufacturer of the precast units shall supply the joint sealant which shall be produced from blends of butyl rubber, refined hydrocarbon, resins, and plasticizing compounds reinforced with inert mineral filler and solvent free.
  - 1. [The sealant shall have an approximate cross section of  $3/8$  in. by  $3-1/2$  in. for single strip application or  $3/8$  in. by  $3/8$  in. square, or  $3/8$  in. diameter cord for multiple cord usage application. Use six cords minimum for multiple cord applications.]
- H. Each section shall have no more than two suitable lifting holes or cast-in lifting devices.
- I. Precast base shall be shaped to receive the ends of pipe sections which are to be connected to the structure.
- J. Pipe openings in base shall be minimum size required to receive pipe and shall be accurately set to conform to the required line and grade.
- K. Pipe shall be joined to wall of concrete manhole with [hydraulic cement, non-shrink grout or flexible manhole sleeve], as shown on the Drawings.
- L. Wall sections shall be a minimum of 4 in. thick, as shown on the Drawings.
- M. Manholes shall have a minimum inside diameter of 4 ft. as shown on the Drawings. The diameter of manholes shall be based on manufacturer's recommendations for the proposed pipe layout shown on the plans. No change orders shall be accepted for upsizing of manholes based on the final layout of piping.
- N. Manholes shall have shaped brick inverts.
- O. Manhole sections shall contain manhole steps accurately positioned and imbedded in the concrete when the section is cast, in accordance with AASHTO M199. These steps shall be extruded aluminum, conforming to Fed Spec. QQ-A-200/8, or polypropylene plastic reinforced with  $3/8$  in. diameter steel rod.
  - 1. Steps shall be drop-front, anti-skid design, 12 in. on center and 10 in. minimum width. Projection of front edge of step shall be greater than or equal to 5 in. from access riser wall.
  - 2. Steps shall be embedded  $3-1/2$  in. into access riser wall or dosing tank wall. Those portions of steps to be embedded in access riser wall shall receive a heavy coat of heavy-bodied bituminous paint. Coating shall be thoroughly dry before steps are embedded in the access riser or dosing tank wall.

3. Steps in precast sections shall be embedded at time of casting.

- P. The date of manufacturer and the name or trademark of the manufacturer shall be clearly marked on the inside of the barrel.

## 2.02 CASTINGS

- A. All frames and covers shall be cast iron, heavy duty, conforming to ASTM A48, Class 35 and shall be designed to safely withstand an AASHTO HS-20 loading.
- B. All castings shall be made in the United States.
- C. Manhole frames and covers shall be of noiseless, non-rocking design with pick holes. The word ["Sewer"] shall be cast on cover in [3 in.] letters, as applicable.
- D. Standard manhole covers and frames shall have a minimum total weight of [475 lbs.] with a clear opening of [24 in.] unless otherwise indicated on the Drawings.
- E. All frames and grates shall be free from blow holes, shrinkage, distortion or other defects. They shall be smooth and well cleaned by shotblasting and fitted together in a satisfactory manner.
- F. All frames and covers shall conform to the MassDOT Specifications M 8.03.0.

## 2.03 PVC PIPE AND FITTINGS (NONPRESSURE)

- A. Polyvinyl chloride (PVC) non-pressure pipe and fittings for gravity sewers shall conform to ASTM D3034, SDR 35 minimum wall thickness.
- B. Pipe shall be furnished in standard lengths of 14 ft. or 20 ft.
- C. PVC shall be bell-and-spigot type with joints made using an integral bell and rubber gasketed joint. Each integral bell joint shall conform to ASTM D3212. Gaskets shall conform to ASTM F477.
- D. Spigot end shall be beveled to ensure proper insertion. Spigot end shall be imprinted with an "assembly stripe" to which the bell end of the mated pipe will extend upon proper jointing of the two pipes.
- E. Pipe ends shall permit checking of the rings with a feeler gauge to ensure the proper location in the coupling grooves.

## 2.04 CAST IRON PIPE (NONPRESSURE)

- A. All cast iron pipe and fittings shall conform to the requirements of CISPI Standard 301, ASTM A888, or ASTM A74.
- B. Castings shall be sound, true to pattern, and compact close grain that permits drilling and cutting by ordinary methods and its interior surface shall be reasonably smooth and free from defects.
- C. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe

Institute or receive prior approval of the Engineer.

- D. Hubless couplings shall conform to the requirements of CISPI 310 or ASTM C1277.
- E. Hubless coupling gaskets shall conform to ASTM C564.

## 2.05 EMBEDMENT MATERIALS

- A. Bedding, haunching, and initial backfill shall be Class I, II, or III soils conforming to ASTM D2321.
  - 1. Class I materials shall be angular crushed stone or rock, dense or open graded with little or no fines (1/4 in. to 1-1/2 in. in size).
  - 2. Class II materials shall be clean, coarse grained materials such as gravel, coarse sands, and gravel/sand mixtures (1-1/2 in. maximum in size).
  - 3. Class III materials shall be coarse grained materials with fines including silty or clayey gravels or sands. Gravel or sand shall comprise more than 50 percent of Class III materials (1-1/2 in. maximum size).
- B. Embedment materials shall be free from lumps of frozen soil or ice.

## 2.06 MORTAR

- A. Mortar shall be a Portland cement mortar conforming to ASTM C270, Type M.
- B. Mortar shall contain a waterproofing admixture similar to those given below.

Product	Manufacturer
Hycrete	Hycrete <a href="http://hycrete.com">hycrete.com</a> 14 Spielman Rd. Fairfield, NJ 07004
ADI-CON CW PLUS	W.R. Meadows <a href="https://www.wrmeadows.com/">https://www.wrmeadows.com/</a> 300 Industrial Drive P.O. Box 338 Hampshire, IL 60140 800-342-5976
Eucon	Euclid Chemical - <a href="http://www.euclidchemical.com/">www.euclidchemical.com/</a> 19215 Redwood Road Cleveland, OH 44110 800-321-7628

## 2.07 NONSHRINK GROUT

- A. Grout shall be cement based, nonmetallic, nonshrink grout that meets performance requirements of ASTM C1107.
- B. Grout shall be similar to those given below.

Product	Manufacturer
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MasterFlow 885	BASF Construction Chemicals - <a href="http://www.master-builders-solutions.basf.us">www.master-builders-solutions.basf.us</a> 23700 Chagrin Blvd. Beachwood, OH 44122
5 Star Grout	Five Star Products – <a href="http://www.fivestarproducts.com">www.fivestarproducts.com</a> 60 Parrott Drive Shelton, CT 06484 800-243-2206
MascoGrout	Mason Supply Corp – <a href="http://www.masco.net">www.masco.net</a> 2637 SE 12 <sup>th</sup> Avenue Portland, OR 97202 503-234-4321

## 2.08 BRICK

- A. Brick for support of cast-iron cover and frame shall be any of the following types:
  - 1. Common brick meeting the physical requirements of ASTM C32, Grade SW.
  - 2. Clay brick meeting the physical requirements of ASTM C32, Grade MS.
- B. Brick for sewer manhole invert channel shall conform to ASTM C32, Grade SS.

## PART 3 – EXECUTION

### 3.01 INSPECTION

- A. Inspect all parts of the Project where SANITARY SEWERAGE SYSTEM is to be installed and the conditions under which the work must be performed. Report in writing to the Construction Manager, with copy to the Engineer, any conditions which might adversely affect the installation. Do not proceed with the installation until defects have been corrected and conditions are satisfactory.
- B. Post installation, Engineer will visually inspect all gravity sewer pipe installed to verify alignment and ensure the pipe is free from obstruction and debris. When the full diameter of the pipe is visible between adjacent manholes, the segment of piping is deemed properly aligned and free of sags and debris. If the segment of pipe fails the visual inspection the pipe shall be cleaned and/or replaced and retested.

### 3.02 PIPE INSTALLATION

- A. General Installation Requirements
  - 1. Piping shall be installed as indicated on the Drawings. Where exact locating dimensions of piping are not given on the Drawings, the Town's and the Engineer's approval shall be obtained for proposed locations before installation.
  - 2. Sewer pipe shall be laid at a minimum of ten feet from the water main. Should local conditions prevent a lateral separation of ten feet, a sewer may be laid closer than ten feet from a water main if:

- a. Approved by DPW
  - b. It is laid in a separate trench.
  - c. The elevation of the top (crown) of the sewer will be at least 18 in. lower than the bottom (invert) of the water main.
3. Sewer pipe shall be laid at a minimum of 5 ft. horizontally from a drainage main and/or 18 in. vertically from a drainage main.
  4. Pipe shall be thoroughly cleaned before installation and shall be maintained free from foreign matter during installation.
  5. Bottom of trench excavation shall be kept dry and free of water during pipe installation. Adequate measures shall be taken to prevent flotation of pipe in the trench.
  6. Each pipe length shall be installed to form a close joint with the next adjoining length and bring inverts to the required grade.
  7. Piping shall be properly graded, free from pockets.
  8. No pipe or fittings shall be permanently supported on saddles, blocking, or stones.
  9. Where necessary, watertight plugs or other approved means shall be employed to close ends of pipeline when laying is not in progress.
  10. Entire length of pipe shall be thoroughly flushed clean following completion of backfill.

**B. PVC Pipe and Fittings**

1. PVC pipe and fittings shall be installed in accordance with manufacturer's recommendations.
2. Buried pipe shall be installed in accordance with ASTM D2321 and ASTM F1668.
3. Gasket shall not be removed from gasket groove for any reason.

**C. Cast Iron Pipe and Fittings**

1. Cast iron pipe and fittings shall be installed in accordance with manufacturer's recommendations.
2. Support horizontal pipe and fittings at sufficiently close intervals to maintain alignment and prevent sagging or grade reversal. Support each length of pipe by an approved hanger located not more than 18 in. from each joint and every 10 ft. horizontally. Support terminal ends of all horizontal runs or branches and each change of direction or alignment with an approved hanger.
3. Installations requiring multiple joints within a 4 ft. developed length shall be supported at every other (alternating) hub or coupling.
4. Vertical components shall be secured at each stack base and at sufficiently close intervals to keep the system in alignment and to adequately support the pipe and its contents, using approved metal clamps or hangers.
5. Maximum deflection should not exceed 1/2 in. per ft. of pipe. For more than five degrees of deflection, fitting should be used.
6. Cast iron pipe and fittings should be connected with shielded hubless coupling manufactured in accordance with CISPI 310 or ASTM C1277.
7. Soil supporting the pipe shall be sufficiently level so that support is provided all along the full length of the pipe. If the base is not sufficiently flat, it shall be overexcavated and backfilled to grade with select soil that can be leveled to become a suitable base.
8. Soil must be placed and compacted under the haunches. Sidefill shall be placed and distributed in one lift up to the spring line on both sides of the pipe to prevent sideshift.

9. A soil arch shall be densely compacted up over the pipe, springing from good abutments or rigid trench sidewalls. In so doing, the pipe and loose soil envelope in which it is packed shall not be crushed or compacted.

### 3.03 MANHOLES

- A. All manholes shall be built in accordance with the Details and in the locations shown on the Drawings and as specified herein.
- B. Structures shall be constructed of precast concrete.
- C. All masonry shall be installed by personnel experienced and skilled in this work, and any person not deemed to be such by the Engineer shall be removed and replaced by a person so qualified.
- D. Manholes shall be constructed as soon as the pipe laying reaches the location of the manhole. Should pipe laying continue without making provision for the completion of the manhole, the Engineer shall have the authority to stop the pipe laying operations until the manhole is completed.
- E. The Contractor shall accurately locate each manhole and set accurate templates to conform to the required line and grade. Any manhole which is mislocated or oriented improperly shall be removed and rebuilt in its proper location, alignment, and orientation at the Contractor's expense.
- F. Unless otherwise specified, all manholes shall be constructed on a 12 in. layer of compacted bedding material. The excavation shall be properly dewatered to provide a dry condition while placing bedding material and setting the base.
- G. Brick invert channels shall be constructed in all manholes to provide a smooth channel for sewage flow through the structure, and shall correspond in shape to the lower half of the pipe. At changes of directions, the inverts shall be laid out in curves of the longest possible radii tangent to the centerline of the sewer pipes. Brick shelves shall be constructed to the elevation of the highest pipe crown and sloped to drain toward the flow channel. Only red sewer brick shall be used for any invert, brick shelves, and manhole frame adjustments. Brick shall comply with ASTM Standard Specification for Sewer Brick (made from clay or shale), Designation C32, for Grade SS.
- H. Special care shall be taken in laying brick inverts. Joints shall not exceed 3/16 inch in thickness and each brick shall be carefully laid in full cement mortar joints on bottom, side, and end in one operation. No grouting or working in of mortar after laying of the brick will be permitted. Bricks forming the shaped inverts in manholes shall be laid on edge.
- I. Invert channels shall be built for future extensions where shown on the Drawings and where directed by the Engineer. Inverts shall not be built above ground. All inverts shall be built with the manhole in place (i.e. at the design elevation) and with all pipes installed.
- J. Precast manholes shall be installed only after Shop Drawings have been approved.

- K. The top grade of the precast concrete section shall be set sufficiently below finished grade to permit a maximum of [five] and a minimum of [two] courses of [8 in.] brick, laid in the flat position, to be used as risers to adjust the grade of the manhole frame. Manhole frames shall be set on a grout pad to make a water-tight fit.
- L. Frames and Covers for manholes shall be of the type and size indicated on the Drawings.  
Frames shall be well bedded in mortar and shall be set accurately to the correct alignment and grade.
- M. The entire exterior surface of all manholes shall be coated with two coats of an approved bitumastic material to produce a dry film thickness of 0.07 in. (seven mils) per coat.

### 3.04 TESTING – GRAVITY SYSTEM

#### A. General Requirements

- 1. The entire sewer system, including piping and manholes, shall be tested for leakage. Pipes shall undergo deflection testing, leakage testing, and televised inspection. Pipes may be tested by the use of either water or low-pressure air.
- 2. Pipeline installation and backfilling is to be completed before pipeline testing takes place. Vacuum testing of manholes shall be completed immediately following assembly of manhole and prior to backfilling.
- 3. Testing shall be done from manhole to manhole. The maximum length of pipe tested shall not exceed 700 ft. If testing is not feasible between manholes due to live sewer service connections, the Contractor shall conduct low pressure air testing at each pipe joint.
- 4. Notice of tests shall be made in writing to the Engineer and the DPW inspector, and received by them not less than five days before the date of test.
- 5. Piping shall be adequately restrained against movement before testing.
- 6. Piping system shall be flushed clean and sediment, scale, dirt, and debris removed before piping is tested.
- 7. If the test section fails any of the tests, the contractor shall repair or replace all defective materials and/or workmanship at no additional cost to the Owner.
- 8. Before submitting system for final approval of the authorities having jurisdiction, the Contractor shall submit to the Engineer a written statement stating that the work has been completed in accordance with the Specifications and Drawings.

#### B. Deflection Test

- 1. Flexible pipe, including “semi-rigid” pipe, is required to show no more than five percent deflection.
- 2. Pipe shall be tested using Standard Mandrel test no sooner than 30 days after backfilling and compacting of line segment, but prior to final acceptance to verify that installed pipe is within specified deflection tolerances. Testing shall conform to ASTM D3034.
- 3. Mandrels shall be go/no go mandrels specifically designed for the pipe material and size being tested. Mandrels that do not specifically state the size and type of piping for which it is applicable shall not be allowed.
- 4. Other testing methods, such as electronic deflectometers or laser profilers, must be submitted for review and approval by the Engineer and the Northbridge DPW prior to use.



C. Leakage Tests

1. Compensating for Groundwater Pressure

- a. Where ground water exists, install pipe nipple at same time sewer line is placed. Use 1/2 in. capped pipe nipple approximately 10 in. long. Make installation through manhole wall on top of sewer line where line enters manhole.
- b. Immediately before performing line acceptance test, remove cap, clear pipe nipple with air pressure, and connect clear plastic tube to nipple. Support tube vertically and allow water to rise in tube. After water stops rising, measure height in feet of water over invert of pipe. Divide this height by 2.3 ft./psi to determine ground water pressure to be used in line testing. Add this pressure to all pressures given below.

2. Exfiltration and infiltration testing shall be performed in accordance with ASTM C969 except as otherwise noted.

3. Exfiltration

- a. When groundwater is less than 2 ft. above the crown of the pipe at the upstream end of the test section, an exfiltration test shall be made.
- b. Total exfiltration shall not exceed 50 gal per inch of pipe diameter per mile of pipe per 24 hours at minimum test head of 2 ft. above crown of pipe at upstream manhole or 2 ft. above groundwater elevation, whichever is greater.
- c. Plug all pipe outlets discharging into the upstream manhole as well as the outlet end of the test section.
- d. Ensure that the downstream end is properly plugged and secured.
- e. Fill the test section with water at the upstream end to a level 2-1/2 ft. above the highest point in sewer pipe, house lead, or groundwater table, whichever is higher.
- f. The water level in the pipe should be held steady for a minimum of three hours and up to 72 hours to ensure that all of the trapped air is removed.
- g. After the stabilization period, refill the water level to the level determined in part e and begin the test. Take water level reading to determine drop of water surface, in inches, for a test period of not less than one hour and no more than 24 hours. Calculate water loss (1 in. of water in 4 ft. diameter manhole equals 8.22 gallons) or measure quantity of water required to keep water at same level. Loss shall not exceed that calculated from allowable leakage according to Table 1.
- h. Leakage for each manhole shall not exceed one gal/vertical ft. of manhole per 24 hours. If the water level is measured in the manhole for the exfiltration test, the leakage associated with the manhole shall be subtracted from the overall leakage of the test section to establish a pass or fail grade for the pipe.
- i. If the measured leakage is less than or equal to the allowable leakage for the project, the section of pipeline is acceptable. If the test section fails, it should be inspected, repaired if needed, and retested in accordance with the previous steps.

4. Infiltration

- a. When groundwater is 2 ft. or more above the crown of the pipe an infiltration test shall be made.
- b. Total infiltration shall not exceed 50 gal per inch of pipe diameter per mile of pipe per 24 hours.
- c. Plug incoming pipes in upstream manhole.
- d. Insert calibrated 90 degree V-notch weir in pipe on downstream manhole.
- e. Allow water to rise and flow over weir until it stabilizes.
- f. Take five readings of accumulated volume over a period of two hours and use average infiltration. Average must not exceed that calculated for two hours from allowable leakage according to Table 1.
- g. If the average leakage is less than or equal to the allowable leakage for the project, the section of pipeline is acceptable. If the test section fails, it should be inspected, repaired if needed, and retested in accordance with the previous steps.

5. Low-Pressure Air

- a. Low-pressure air testing shall be performed in accordance with the procedures described in ASTM C828 or ASTM F1417, except as otherwise noted. For making low-pressure tests, the Contractor shall use equipment specifically designed and manufactured for the purpose of testing sewer pipelines using low-pressure air. The equipment shall be provided with a regulator valve or air safety valve so set that the internal air pressure in the pipeline cannot exceed 8 psig.
- b. Air testing for sections of pipe shall be limited to lines less than 27 in. average inside diameter for which groundwater is less than 2 ft. above the crown of the pipe at the upstream end.
- c. After manhole-to-manhole section of sanitary sewer main has been backfilled and cleaned, and prior to any service lines being connected to new line, plug line at each manhole with pneumatic plugs, inflated to 25 psig.
  - i) For concrete pipe, flood pipe and allow two hours to saturate concrete. Then drain and plug concrete pipe.
  - ii) Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be tested. Pneumatic plugs shall resist internal testing pressures without requiring external bracing or blocking.
- d. Low pressure air shall be introduced into this sealed line until the internal air pressure reaches 4 psig. A minimum of two minutes shall be allowed for the air pressure to stabilize. After the stabilization period (3.5 psig minimum pressure in the pipe), the air hose from the control panel to the air supply shall be disconnected. Pressure shall be at 3.5 psig before beginning the test.
- e. To determine air loss, measure time interval for pressure to drop from 3.5 psig to 2.5 psig. Time must meet or exceed that listed in Table 2 below for pipe diameter and length.
- f. When the sewer section to be tested contains more than one size pipe, the maximum allowable time shall be based on the largest diameter pipe in the section, and shall be the time shown in the table reduced by 30 seconds.
- g. Repair and retest any section of pipe which fails to meet requirements.

6. Manhole Vacuum Testing

- a. Manholes shall be tested in accordance with ASTM C1244.
- b. Manhole testing shall not apply to existing manholes or to existing manholes which have been converted to drop manholes by the Contractor.

Manhole to pipe connection shall be a flexible connector and joints shall be grouted from the outside only. All lift holes shall be plugged inside and out with nonshrink grout.

- c. All pipes entering the manhole shall be plugged. The Contractor shall securely brace the plugs in order to keep them from being drawn into the manhole. The test head shall be placed at the inside of the top of the manhole and the seal inflated in accordance with the manufacturer's recommendations.
  - d. A vacuum of 10 inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time for the vacuum to drop to 9 inches of mercury shall not be less than that shown in Table 3 below.
7. Promptly following satisfactory completion of the leakage testing, a report fully describing test procedures and listing test results shall be submitted to the Engineer and to the governmental agencies having jurisdiction. The report shall be signed by the Contractor's superintendent.
  8. Upon successful completion of the tests, plug or caps installed for testing shall be removed.
  9. If, in the judgement of the Engineer, it is impractical to follow the foregoing procedure exactly for any reason, modification in the procedure shall be made as necessary and accepted, but in any event the Contractor shall be responsible for the ultimate tightness of the line within the above leakage and pressure requirements.

<b>TABLE 1</b>				
<b>Water Test Allowable Leakage</b>				
Diameter of Riser or Stack in Inches	Volume per Inch of Depth		Allowance Leakage*	
	Inch	Gallons	Pipe Size in	Gallons/Minute per 100 ft.
1	0.7854	.0034	6	0.0039
2	3.1416	.0136	8	0.0053
2.5	4.9087	.0212	13	0.0066
3	7.0686	.0306	12	0.0079
4	12.5664	.0306	15	0.0099
5	19.6350	.0544	18	0.0118
6	28.2743	.1224	21	0.0138
8	50.2655	.2176	24	0.0158
			27	0.0177
			30	0.0197
			36	0.0237
			42	0.0276
For other diameters, multiply square of diameters by value of one in. diameter			Equivalent to 50 gallons per inch of inside diameter per mile per 24 hours	

\*Allowable leakage rate shall be reduced to 10 gallons per inch of inside diameter per mile per 24 hours, when sewer is identified as located within a 25-year flood plain.

**TABLE 2**  
**Low Pressure Air Test**  
**Time Allowed for Pressure Loss from 3.5 psig to 2.5 psig**

Pipe (in)	Specification Time for Lengths Below (Min: Sec)											Time for Longer Length
	100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	500 ft	550 ft	600 ft	
6	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:25	7:07	7:50	8:33	0.854 x L (ft)
8	7:33	7:33	7:33	7:33	7:36	8:52	10:08	11:24	12:40	13:56	15:12	1.519 x L (ft)
10	9:27	9:27	9:27	9:54	11:52	13:51	15:50	17:48	19:47	21:46	23:45	2.374 x L (ft)
12	11:20	11:20	11:20	14:15	17:06	19:57	22:48	25:39	28:30	31:20	34:11	3.419 x L (ft)
15	14:10	14:10	17:48	22:16	26:43	31:10	35:37	40:04	44:31	48:58	53:25	5.342 x L (ft)
18	17:00	19:14	25:39	32:03	38:28	44:52	51:17	57:42	64:06	70:31	76:56	7.692 x L (ft)
21	19:50	26:11	34:54	43:38	52:21	61:05	69:48	78:32	87:15	95:59	104:42	10.47 x L (ft)
24	22:48	34:11	45:35	56:59	68:23	79:47	91:10	102:34	113:58	125:22	136:46	13.67 x L (ft)
27	28:51	43:16	57:42	72:07	86:33	100:58	115:24	129:49	144:14	158:40	173:05	17.3 x L (ft)
30	35:37	53:25	71:14	89:02	106:51	124:39	142:28	160:16	178:05	195:53	213:41	21.36 x L (ft)
33	43:06	64:38	86:11	107:44	129:17	150:50	172:23	193:55	215:28	237:01	258:34	25.85 x L (ft)

<b>TABLE 3</b> <b>Vacuum Testing Time (Seconds) for Manholes</b>			
Depth (feet)	Manhole Diameter		
	48	60	72
0-8	20	26	33
10	25	33	41
12	30	39	49
14	35	46	57
16	40	52	67
18	45	59	73
20	50	65	81
22	55	72	89
24	59	78	97
26	64	85	105
28	69	91	113
30	74	98	121

### 3.05 CLEANING

- A. At the conclusion of the work, the Contractor shall thoroughly clean the sewers by flushing with water or other means to remove dirt, stones, and other material. Prior to acceptance, all pipelines shall be video inspected. Three copies of the final inspection shall be submitted to the Engineer for their records. The inspection shall be recorded on DVD media.

### 3.06 AS-BUILTS

- A. The Contractor shall provide the Engineer with as-builts of all the newly installed lines and structures. The as-built shall include swing tie locations and depths to all pipes and structures, and shall be shown on a site plan and in AutoCAD format.

END OF SECTION – 33 30 00